SMI21 DCmind Brushless Motors

User Manual and Safety Notice

Important Notes

- This manual is part of the product.
- Read and follow the instructions in this manual.
- Keep this manual in a safe place.
- Give this manual and any other documents relating to the product to anyone that uses the product.
- Read and be sure to comply with all the safety instructions and the section "Before you Begin - Safety-Related Information".
- Please consult the latest catalogue to find out about the product's technical specifications.
- We reserve the right to make modifications without prior notification.

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About This Manual

This manual applies to SMI21 DCmind brushless products:

- 801400SMI21, 801495SMI21, 801496SMI21, 801410SMI21
- 801800SMI21, 801896SMI21, 801897SMI21, 801810SMI21
- 802800SMI21, 802896SMI21, 802897SMI21, 802810SMI21

Reference source for manuals
The manuals can be downloaded from our website at the following address:
http://www.crouzet.com/

Units
SI units are the default values.

Risk Categories

In this manual, safety instructions are identified by warning symbols.
Depending on how serious the situation is, the safety instructions are split into 3 risk categories.

DANGER

DANGER indicates a directly dangerous situation which, if the instructions are not followed, will **inevitably** lead to a serious or fatal accident.

WARNING

WARNING indicates a possibly dangerous situation which, if the instructions are not followed, will **in some cases** lead to a serious or fatal accident or cause damage to equipment.

CAUTION

CAUTION indicates a potentially dangerous situation which, if the instructions are not followed, will **in some cases** lead to an accident or cause damage to equipment.

1. INTRODUCTION

1.1. Motor Family

SMI21 DCmind brushless motors are brushless DC motors, with a control circuit board integrated in the motor.

1.2. Characteristics

SMI21 DCmind brushless motors are intelligent servomotors for speed, position and torque control applications. They can be configured via a Human-Machine Interface (HMI).
They are equipped with 2 unshielded cables as standard, 1 for the power, 1 for the control signals.

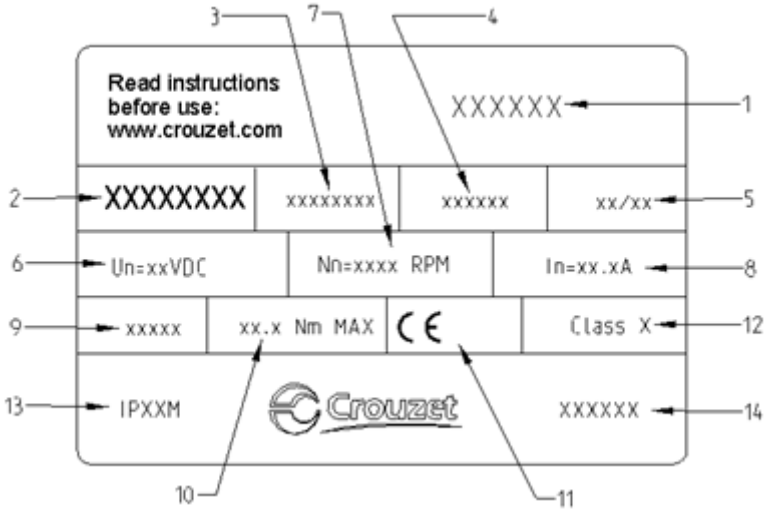
1.3. Options

The motors can be supplied with options, such as:

- Different gearboxes
- A failsafe holding brake
- Different motor output shaft versions

1.4. Identification Label

The label contains the following data:



1. Product family code.
2. Product part number.
3. Reserved zone.
4. Zone reserved for specific customer marking.
5. Week/year manufacturing date.
6. Operating voltage.
7. Nominal motor speed at 24 V.
8. Nominal motor current.
9. Reduction ratio (for geared motor versions).
10. Maximum nominal torque applicable to the gearbox (for geared motor versions).
11. Motor approvals.
12. Insulation system temperature class.
13. Product degree of protection (sealing) during operation (excluding output shaft).
14. Country of origin.

1.5. Product Coding

80 XX XX SMI21: Product family on SMI21 electronic base

PRODUCT REFERENCE	8 0	X X	X X	X X

Motor

Type of stator:

14: 30mm brushless stator

18: 50 mm brushless stator

28: 50 mm brushless stator high torque

Gearbox adaptation

00: no gearbox

10: RAD10 gearbox

95: P52 gearbox

96: P62 gearbox

97: P81 gearbox

Increment numbers

2. BEFORE YOU BEGIN - SAFETY-RELATED INFORMATION

2.1. Personnel Qualifications

Only qualified personnel who are familiar with and fully understand the contents of this manual are authorized to work on and with this product.

Qualified personnel must be familiar with current standards, regulations and requirements concerning prevention of accidents during work undertaken on and with this product.

These qualified personnel must have undergone safety training in order to be able to detect and avoid related hazards.

Their professional training, knowledge and experience renders such qualified personnel capable of preventing and recognizing potential hazards that might be generated through use of the product, modifying settings and the mechanical, electrical and electronic equipment in the whole installation.

2.2. Use in Compliance with Industry Practice

As demonstrated in these instructions, this product is a component designed for use in industrial environments.
The current safety instructions, specified conditions and technical specifications must be complied with at all times.
Before starting to use the product, undertake a risk analysis using actual examples. Depending on the result, the necessary safety measures must be implemented.
Since the product is used as a component in an overall system, it is the user's responsibility to guarantee people's safety through the concept of the overall system (e.g. concept of a machine).
Only use original manufacturer accessories and spare parts.
The product must not be used in explosive atmospheres (Ex zone).
All other types of use are deemed to be non-compliant and can be dangerous.
Only qualified personnel are authorized to install, operate, maintain and repair electrical equipment.

2.3. Basic Information

DANGER

DANGEROUS PHENOMENON LINKED TO ELECTRIC SHOCK, EXPLOSION OR EXPLOSION DUE TO AN ELECTRIC ARC

• Only qualified personnel who are familiar with and fully understand the contents of this manual are authorized to work on this product. Only qualified personnel are authorized to undertake installation, setting, repair and maintenance.
• The installation manufacturer is responsible for complying with all the applicable requirements and regulations with regard to grounding the drive system.
• It is the user's responsibility to define whether it is necessary to ground the motor, depending on its intended use.
• Do not touch unprotected live parts.
• Only use electrically-isolated tools.
• AC voltages can be connected to unused conductors in the motor cable. Isolate unused conductors at both ends of the motor cable.
• The motor produces a voltage when the shaft turns. Protect the motor shaft from any external drive operation before working on the drive system:
– De-energize all connections.
– Attach a notice saying "DO NOT START UP" on all the switches.
– Protect all the switches from switching on.
– Wait for the internal motor capacitors to discharge. Measure the voltage on the power cable and check that it is less than 12 VDC.
• Install protective covers and ensure they are closed before energization.

Failure to comply with these precautions will result in death or serious injury.

WARNING

LOSS OF COMMAND CONTROL
• When perfecting the command concept, the installation manufacturer must take account of the possibilities for potential failure of command paths and provide, for certain critical functions, the means of returning to safe states during and after the failure of a command path.
Examples of critical command functions are:
EMERGENCY STOP, end position limiting, network outage and restarting.
• Separate or redundant command paths must be available for critical functions.
• Comply with the accident prevention instructions and all current safety directives.
• Any installation in which the product described in this manual has a central role must be carefully and meticulously checked prior to commissioning to ensure it is working properly.
Failure to comply with these precautions can result in death or serious injury.

WARNING

UNBRAKED MOVEMENT
In the event of a power outage and errors resulting in disconnection of the power stage, the motor is no longer braked in a controlled way and can cause damage.
• Prevent access to the hazardous zone.
• If necessary, use a damped mechanical stop or a service brake.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

2.4. Standards and concepts

The product is ROHS confirmed following European Directive 2011/65/CE. Following this confirmation, the product is CE marked.
The electrical design follows the IEC 60335-1 and IEC 60950-1 standards.

3. PRECAUTIONS FOR USE CONCERNING THE MECHANICS

3.1. Data specific to the motor shaft

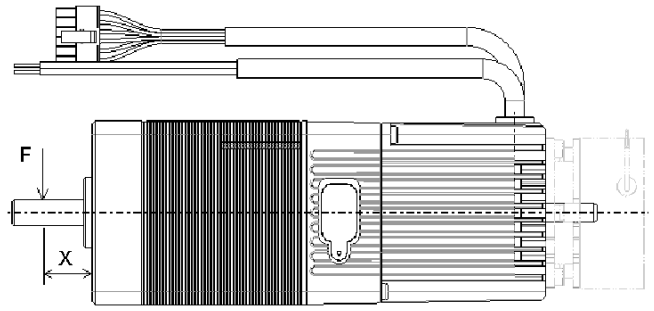
3.1.1. Press-fit force

WARNING

MOTOR MECHANISM
Exceeding the maximum permissible forces on the shaft leads to rapid bearing wear, a broken shaft or damage to any accessories (encoder, brake, etc.)
• Never exceed the maximum axial and radial forces.
• Protect the shaft from any impact.
• When press-fitting components, do not exceed the maximum permissible axial force.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

The maximum press-fit force is limited by the maximum permissible axial force on the ball bearings. This maximum axial force is stated in the motor technical data sheet.
Alternatively, the component to be fixed in position can be clamped, glued or shrunk-fit.

3.1.2. Radial load on the shaft



The application point **X** of the radial force **F** depends on the motor size.
This information appears in the motor technical data sheet.

The maximum axial and radial loads must not be applied simultaneously.

3.2. Options

3.2.1. Holding brake

SMI21 DCmind brushless motors can be equipped as standard with a failsafe electromechanical brake.
The holding brake is designed to lock the motor shaft in a de-energized state.
The holding brake is not a safety function.
How it is controlled is described in the "Connecting the Holding Brake" section.

3.2.2. Gearboxes

SMI21 DCmind brushless motors can be equipped with different types of gearbox.
The gearboxes offered as standard in the catalogue are planetary gearboxes which combine compact size and robust design, and worm gearboxes that allow a shaft output at right-angles to the motor shaft.

3.2.3. Other

Other types of adaptation are possible on request, please contact the sales department.

4. ACCESSORIES

4.1. Starter Kit

This kit consists of a 2-meter long micro USB B to USB A (MOLEX 68784-0003) connecting cable and a USB stick containing the "Crouzet Interface" parameter-definition software and installation drivers for this HMI.
This starter kit can be obtained by ordering part number **79 298 008**.

4.2. Extra Stoppers

A kit of 5 extra stoppers is available by ordering part number: 79 298 xxx

5. INSTALLATION

Installation must, as a general rule, be performed in accordance with good practice.

WARNING

HEAVY WEIGHT AND FALLING PARTS
The motor can be extremely heavy.
• When mounting, take the weight of the motor into account.
• Mounting (screw tightening torque) must be performed in such a way that the motor cannot become detached, even if subjected to strong accelerations or constant jolting.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

WARNING

STRONG ELECTROMAGNETIC FIELDS
Motors can generate locally powerful electrical and magnetic fields. These can cause sensitive equipment to fail.
• Keep people with implants such as pacemakers away from the motor.
• Do not place sensitive equipment in the immediate vicinity of the motor.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

WARNING

UNEXPECTED BEHAVIOR CAUSED BY DAMAGE OR FOREIGN BODIES
Following damage to the product or the presence of foreign bodies, deposits or penetration of fluid, unexpected behavior can occur.
• Do not use damaged products.
• Make sure that no foreign body has been able to penetrate the product.
• Check that the power supply lead seals and cable entries have been positioned correctly.
• Check that the stopper protecting the USB B to USB A micro connector has been positioned correctly.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

WARNING

HOT SURFACES
The product's metal surface can heat up to more than 70°C in certain types of use.
• Avoid all contact with the metal surface.
• Do not place flammable or heat-sensitive components in the immediate vicinity.
• Assemble components in the best way for heat dissipation.
Failure to comply with these precautions can result in injury or damage to equipment.

WARNING

DAMAGE AND DESTRUCTION OF THE MOTOR CAUSED BY STRESS
The motor is not designed to carry loads. If subjected to stress, the motor can be damaged, or even fall.
• Do not use the motor as a step.
• Prevent the motor from being used in any way other than its intended purpose by installing guards or displaying safety instructions.
Failure to comply with these precautions can result in injury or damage to equipment.

CAUTION

VOLTAGE SURGES
During braking phases, the motor generates voltage surges.
• Check that these voltage surges are acceptable to other devices connected on the same power supply.
• If possible, use an external circuit to limit voltage surges.
if the brake is used intensively.
Failure to comply with these precautions can result in injury or damage to equipment.

5.1. Overview of the Installation Procedure

The installation procedure is described in the following sections:

- Electromagnetic Compatibility (EMC)
- Prior to Mounting
- Mounting the Motor
- Electrical Installation
- Connecting the USB cable to Set the Motor Parameters

Check that these sections have been read and understood, and that installation has subsequently been executed correctly.

5.2. Electromagnetic Compatibility (EMC)

DANGER

INTERFERENCE AFFECTING SIGNALS AND EQUIPMENT
Disturbed signals can cause equipment to behave unpredictably.
• Wire up products in compliance with the specific EMC recommendations for each device.
• Make sure that these EMC recommendations are executed correctly.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

Recommendations in terms of EMC: Installing the motor power supply leads
When planning the wiring, take account of the fact that the motor power supply leads must be kept separate from line supplies or cables carrying signals.

Comply with the following measures as concerns EMC.

Measures relating to EMC	**Effect**
Keep the cables as short as possible. Do not install unnecessary cable loops.	Reduces stray couplings, both capacitive and inductive.
Ground the product.	Reduces emissions, improves immunity to interference.
If using shielded cables, install the cable shielding so that it is in contact with the widest possible surface area, use cable grips and ground strips.	Reduces emissions.
Keep the motor power supply leads separate from cables carrying signals or use shielding plates.	Reduces stray cross-couplings.
If using shielded cables, install the cables without any disconnection points. 1)	Reduces stray radiation.

1) When a cable is disconnected for installation, the cables must be connected at the disconnection point via a shelding connection and a metal box.

Equipotential bonding conductors
If using shielded cables, differences in potential can generate unauthorized currents on the cable shielding.
Use equipotential bonding conductors to minimize currents on the cable shielding.

5.3. Prior to Mounting

Look for any damage
Damaged drive systems must neither be mounted nor used.
⇨ Check the drive system prior to mounting, looking out for any visible signs of damage.

Clean the shaft
On leaving the factory, the motor shaft extensions are coated with a film of oil.
If transmission devices are to be glued on, it may be necessary to remove the film of oil and clean the shaft.
If necessary, use degreasing products in accordance with the glue manufacturer's instructions.
⇨ Avoid any direct contact between the skin or sealing materials and the cleaning product used.

Flange mounting surface
The mounting surface must be stable, flat and clean.
⇨ In regards to installation, make sure that all dimensions and tolerances are respected.

Specification of power supply leads
The power supply leads for the motor and its accessories must be selected carefully on the basis of their length, the motor supply voltage, the ambient temperature, the current level circulating therein, and their environment.

⚠ WARNING

DAMAGE AND FIRE DUE TO INCORRECT INSTALLATION
Repeated force and movement around the grommets can damage the cables.
• Comply with the stated bend radius.
• Avoid subjecting the grommets to repeated force or movement.
• Attach the power supply cables close to the grommets using a strain relief.
Failure to comply with these precautions can result in injury or damage to equipment.

5.4. Mounting the Motor

DANGER

HOT SURFACES
The motor's surface can heat up to more than 70°C in certain types of use.
• Avoid contact with hot surfaces.
• Do not place flammable or heat-sensitive components in the immediate vicinity.
• Assemble components in the best way for heat dissipation.
• Check the temperature when performing a test.
Failure to comply with these precautions can result in injury or damage to equipment.

WARNING

UNEXPECTED MOVEMENT DUE TO ELECTROSTATIC DISCHARGES
Electrostatic discharges (ESD) on the shaft can, in rare cases, lead to encoder system failures and generate unexpected motor movements.
• Use conductive parts (e.g. antistatic straps) or other appropriate measures to avoid a static charge due to movement.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

WARNING

UNINTENDED BEHAVIOR CAUSED BY MECHANICAL DAMAGE TO THE MOTOR
Exceeding the maximum permissible forces leads to rapid bearing wear, a broken shaft or damage to the internal encoder.
• Never exceed the maximum axial and radial forces.
• Protect the shaft from any impact.
• When press-fitting components, do not exceed the maximum permissible axial force.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

Mounting position
The motor can be mounted in any position.

Mounting
When mounting the motor on the flange, the motor must be aligned precisely in both the axial and radial directions. All the fixing screws must be tightened to the tightening torque stipulated by the application, taking care not to generate any warping.

Install the transmission devices
If the transmission device is installed incorrectly, this can damage the motor.
Transmission devices such as pulleys and gears must be mounted in compliance with the maximum axial and radial loads defined in each motor's technical data sheet.
Follow the transmission device manufacturer's assembly instructions.
The motor and the transmission device must be aligned precisely both axially and radially. If this is not done, it will result in abnormal operation, damage to the bearings and significant wear.

5.5. Electrical Installation

These motors are not designed to be connected directly to the line supply.
It is the installer's responsibility to define the electrical protection devices to be implemented according to the regulations applicable to the end product range of application.
For the power supply to the power part we recommend using a double-insulated stabilized power supply.
The motor is not protected against polarity reversals on the power part.
The motor is regenerative, in other words it can feed back energy to the power supply during braking phases. Voltage surges created in this way can reach levels that risk destroying the motor itself or devices placed on the same power supply.

DANGER

ELECTRIC SHOCK
High voltages can appear unexpectedly on the motor connection.
• The motor produces a voltage when the shaft turns. Protect the motor shaft from any external drive operation before working on the drive system.
• The system manufacturer is responsible for complying with all applicable regulations with regard to grounding the drive system.
Failure to comply with these precautions will result in death or serious injury.

WARNING

UNEXPECTED MOVEMENT
As a result of incorrect wiring or other error, the drives can execute unexpected movements.
• Do not start up the installation if there is anybody or any obstacle in the danger zone.
• Execute the initial test movements without loads connected.
• Do not touch the motor shaft or related drive elements.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

WARNING

VOLTAGE SURGES
During braking phases, the motor generates voltage surges.
• Check that these voltage surges are acceptable to other devices connected on the same power supply.
• If possible, use an external circuit to limit voltage surges.
if the brake is used intensively.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

CAUTION

FIRE CAUSED BY BAD CONTACTS
If the connector is not properly inserted the motor connector can overheat, causing the contacts to melt due to an electric arc.
• Incorrect connection can cause overheating due to an electric arc.
Failure to comply with these precautions can result in injury or damage to equipment.

CAUTION

IRREPARABLE PRODUCT DAMAGE CAUSED BY REVERSED POLARITY
Incorrect connection of the power can result in reversed polarity, resulting in destruction of the circuit board inside the motor.
• Check the conformity of the power connections.
• Place a slow-blow fuse on the power supply that is appropriately sized for the current the motor needs to absorb in the application.
Failure to comply with these precautions can result in injury or damage to equipment.

Connecting the protection conductor
It is the installer's responsibility to define whether the motor needs to be grounded.
The mounting flange should be used for this purpose.
Never connect or disconnect the product power supply leads while the voltage is applied.

5.5.1. Connecting the Holding Brake (Optional)

WARNING

LOSS OF BRAKING FORCE DUE TO WEAR OR HIGH TEMPERATURE
Engaging the holding brake while the motor is running leads to rapid wear and loss of braking force.
• Do not use the brake as a service brake.
• Note that "emergency stops" can also cause wear.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

WARNING

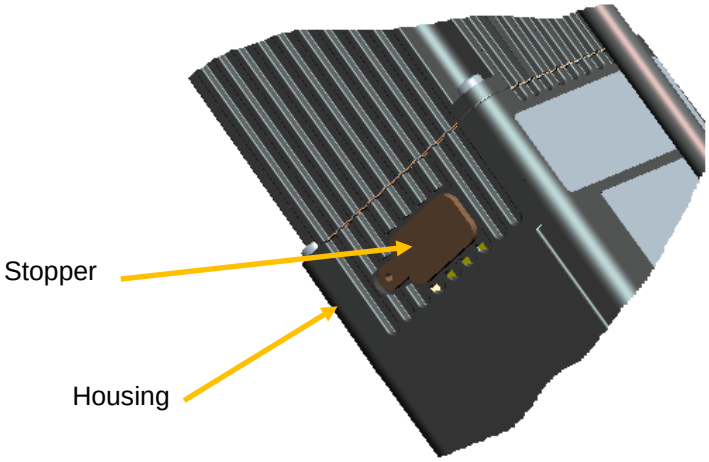
UNEXPECTED MOVEMENT
Releasing the holding brake can result in unexpected movement on the installation.
• Make sure this cannot cause any damage.
• Do not continue with the test if there is anybody or any obstacle in the danger zone.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

CAUTION

MALFUNCTION OF THE HOLDING BRAKE DUE TO INAPPROPRIATE VOLTAGE
• If the voltage is too low, the holding brake cannot release, resulting in wear.
• In the event of voltages higher than the specified value, the holding brake will be subject to significant overheating.
Failure to comply with these precautions can result in injury or damage to equipment.

A motor with a holding brake needs a corresponding control logic which releases the holding brake at the start of the rotation movement, locking the motor shaft in time when the motor stops.

5.6. USB Connector



The motor is equipped with a USB B to USB A micro connector, which can be accessed by removing the stopper from the housing.
The stopper prevents penetration of foreign bodies or fluids inside the motor.
The stopper prevents fingers or any inappropriate object making contact with the USB B to USB A micro connector.

It must be replaced carefully after use, in order to keep the motor sealed.

WARNING

UNEXPECTED MOVEMENT DUE TO ELECTROSTATIC DISCHARGES
Electrostatic discharges (ESD) on the USB B to USB A micro connector can, in some cases, lead to deterioration or destruction of some system components and generate unexpected motor operation.
• Never touch the connector with your fingers or any inappropriate object.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

CAUTION

LOSS OF SEALING
The stopper ensures the motor is sealed.
• Replace it after completing parameter definition.
• Make a visual check to ensure it is in place.
Failure to comply with these precautions can result in injury or damage to equipment.

6. OPERATION

6.1. Preparation for Operating

Prior to operating:

- ⇨ Check that the mechanical installation is correct.
- ⇨ Check that the electrical installation has been carried out professionally: pay special attention to the protective conductor connections and the grounding connections. Check that all the junctions are correct, properly connected and that the screws are fully tightened.
- ⇨ Check the ambient conditions and operating conditions: make sure that the stipulated ambient conditions are adhered to and that the drive solution conforms to the expected operating conditions.
- ⇨ Check that any transmission devices that are already mounted are balanced and aligned precisely.
- ⇨ Check that the operating conditions do not generate abnormal voltage surges for the product or the application.
- ⇨ Check that the holding brake can withstand the maximum load. After applying the braking voltage, make sure that the holding brake is fully released. Make sure that the holding brake is fully released before initiating a movement.
- ⇨ Check that the USB micro connector's protective stopper has been replaced correctly.

⚠ WARNING

UNEXPECTED MOVEMENT
As a result of incorrect wiring or other error, the drives can execute unexpected movements.
• Check the wiring.
• Do not start up the installation if there is anybody or any obstacle in the danger zone.
• Execute the initial test movements without loads connected.
• Do not touch the motor shaft or related drive elements.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

⚠ WARNING

ROTATING PARTS
Rotating parts can cause injuries, trap clothing or hair. Separate parts or unbalanced parts can be ejected.
• Check that all rotating parts are fitted properly.
• Use a protective cover for rotating parts.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

⚠ WARNING

FALLING PARTS
The motor can move due to the reaction torque; it can topple over and fall.
• Fix the motor firmly in place so that it cannot become detached during rapid acceleration.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

CAUTION

HOT SURFACES
The motor's surface can heat up to more than 70°C in certain types of use.
• Avoid contact with hot surfaces.
• Do not place flammable or heat-sensitive components in the immediate vicinity.
• Assemble components in the best way for heat dissipation.
• Check the temperature when performing a test.
Failure to comply with these precautions can result in injury or damage to equipment.

CAUTION

VOLTAGE SURGES
During braking phases, the motor generates voltage surges.
• Check that these voltage surges are acceptable to other devices connected on the same power supply.
• If possible, use an external circuit to limit voltage surges.
if the brake is used intensively.
Failure to comply with these precautions can result in injury or damage to equipment.

7. PRODUCT OVERVIEW

7.1. Description of the Product

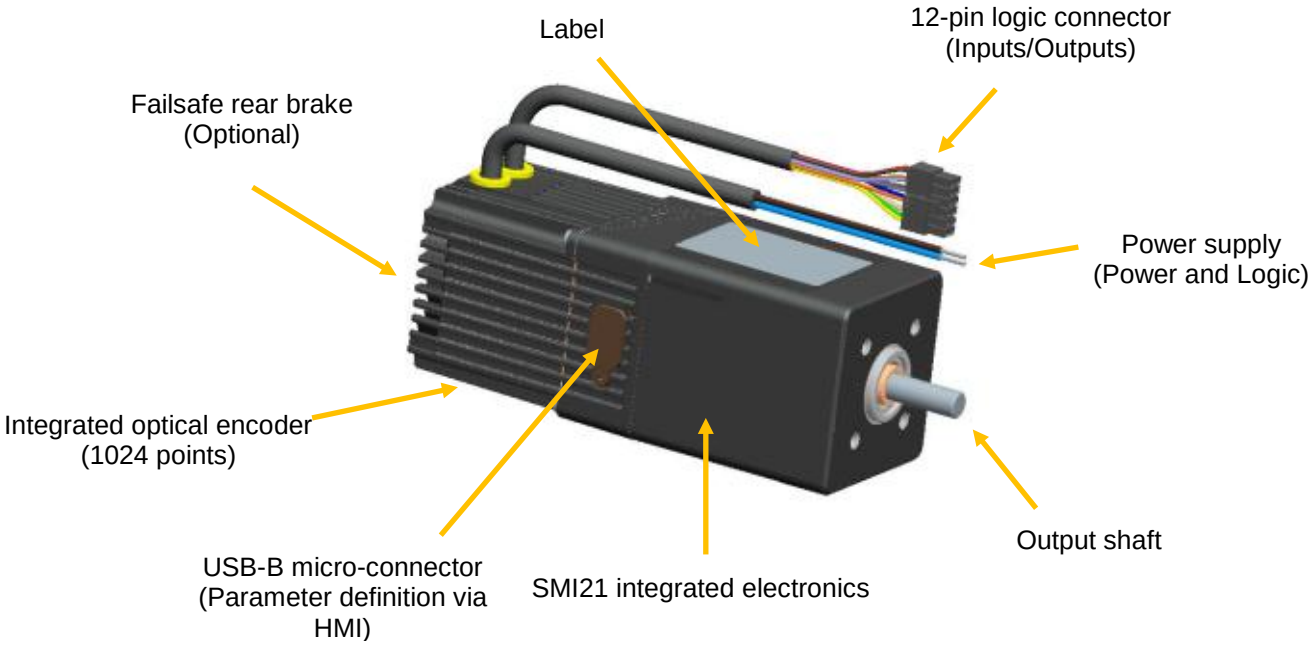


Figure 1

7.2. SMI21 Control Electronics

The SMI21 electronic control card contains the control electronics for a brushless motor, integrated in the motor body.
This electronics is used for:

- Power switching of the motor in sine mode (field-oriented control (FOC)).
- Position-Speed-Torque and Current control algorithms.
- Use of preconfigured programs which can perform numerous routine applications.
- Management of different types of operation:
  - "Stand-alone" motor without external PLC.
  - Use with other motors incorporating SMI21 or TNI21 or Motomate electronics.
  - Use with a programmable controller, with the SMI21 simplifying motor management.
- The interface with parameter-definition software installed on the PC:
  - Easy to use, even by a layman, thanks to simplified application programs that are quick to get up and running.
  - Wide choice of expert programs covering a wide range of applications.
  - USB connection via a commercially-available standard cable (can be supplied on request).
- Management of 6 inputs and 4 outputs to control the motor:
  - 2 inputs that can be configured for 0-10 V 10-bit analog or PWM or digital control
  - 4 digital inputs
  - 1 output that can be configured as PWM or frequency or digital
  - 1 output that can be configured as PWM or digital
  - 2 digital outputs

As standard, the motors have an internal encoder with 4096 points per revolution that can reach high positioning and control resolutions.

7.3. "DCmind-Soft" PC Parameter-Definition Software

This software can be downloaded from the Internet at the following address: http://www.crouzet.com/.
It can also be supplied as a kit, see "Programming Kit" section.

This "DCmind-Soft" software is needed the first time the motor is used and for debugging.

It is used for:

- Selecting the motor operating program:
  - Position
  - Speed
  - Torque
  - Quick and easy starting using preprogrammed applications.
  - Use of "expert" programs that provide access to all settings.

- The various settings needed for the application to work correctly.
- Updating the "firmware" motor program using the bootloader function.

8. TECHNICAL SPECIFICATIONS

8.1. Electrical Data

Maximum Product Specifications				
Parameters	Value			Unit
Supply voltage $V_{DC\ MAX}$	60			V
Maximum current $I_{DC\ MAX}$	20			A
Maximum input voltage $V_{IN\ MAX}$	50			V
Maximum output voltage $V_{OUT\ MAX}$	60			V
Maximum output current $I_{OUT\ MAX}$	50			mA
Operating Specifications				
Parameters	Min	Typical	Max	Unit
Supply voltage V_{DC}	9	12 / 24 / 48	56	V
Current I_{DC}	-	10	17	A
Motor consumption when stopped without holding W_0	-	1	-	W
Input Specifications				
Parameters	Min	Typical	Max	Unit
Input impedance In1 to In4 $R_{IN\ DIG}$	-	57	-	Ω
Input impedance I5 to I6 $R_{IN\ ANA/PWM}$	-	69	-	Ω
Low logic level on inputs In1 to In4 $V_{IL\ DIG}$	0	-	2	V
High logic level on inputs In1 to In4 $V_{IH\ DIG}$	4	-	50	V
Low logic level on inputs I5 to I6 $V_{IL\ PWM}$	0	-	2	V
High logic level on inputs I5 to I6 $V_{IH\ PWM}$	7.5	-	50	V
Output Specifications				
Parameters	Min	Typical	Max	Unit
Low logic level on outputs Out1 to Out4 V_{OL} R_L = 4 K7Ω, V_{DC} = 24 V	0	-	0.2	V
High logic level on outputs Out1 to Out4 V_{OL} R_L = 4 K7Ω, V_{DC} = 24 V	VDC – 0.5 V	-	VDC	V
PNP open collector type				

8.2. Generic Data

General Specifications		
Parameters	Value	Unit
Ambient motor temperature	-30 to +70	°C
Insulation class (compliant with directive IEC 60085)	E	/
Ingress protection (excluding output shaft)	IP65M	/

8.3. Control Logic Bundle

This consists of a UL approved cable Style 2464 80°C 300 V, 500 mm long as standard, fitted with a 12-pin MOLEX connector part number **43025-1200**:

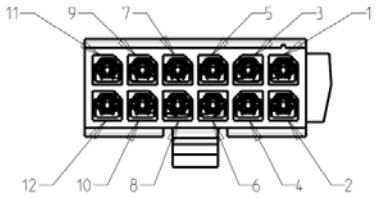


Figure 2

Pin	Type	Wire Color (AWG24)
1	Input no. 1 – Digital	Green
2	Input no. 2 – Digital	Yellow
3	Input no. 3 – Digital	White
4	Input no. 4 – Digital	White/Brown
5	Input no. 5 – Analog setpoint or PWM (or Digital)	Blue
6	Input no. 6 – Analog setpoint or PWM (or Digital)	Orange
7	Logic ground - 0 VDC	Black
8	Logic ground - 0 VDC	White/Black
9	Output no. 1 – Digital or PWM	Brown
10	Output no. 2 – Digital or PWM	Purple
11	Output no. 3 – Digital	Red
12	Output no. 4 – Digital	Gray

A label attached to the motor summarizes this information:

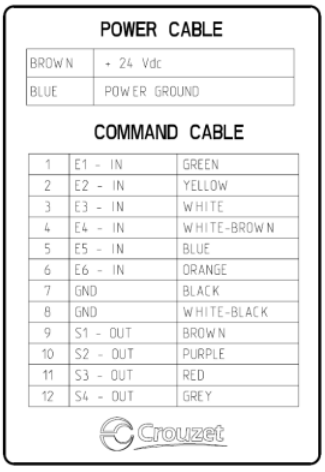

POWER CABLE
BROWN + 24 Vdc
BLUE POWER GROUND
COMMAND CABLE
1 E1 - IN GREEN
2 E2 - IN YELLOW
3 E3 - IN WHITE
4 E4 - IN WHITE-BROWN
5 E5 - IN BLUE
6 E6 - IN ORANGE
7 GND BLACK
8 GND WHITE-BLACK
9 S1 - OUT BROWN
10 S2 - OUT PURPLE
11 S3 - OUT RED
12 S4 - OUT GREY
Crouzet

Figure 3

Connector part numbers to be used for connection:

On a card: MOLEX series 43045
On a cable: MOLEX series 43020

With cables more than 3 m long, tests must be performed in situ.

8.4. Power Supply Cable

Type	Wire Color (AWG16)
Power supply: 12 VDC → 48 VDC	Brown
Power ground: 0 VDC	Blue

The power supply cable is UL approved Style 2517 105°C 300 V, 500 mm long as standard.

When a cable extension is used, the cable cross-section size should depend on the current drawn and the cable length.

9. MOTOR ELECTRICAL CONNECTION

9.1. Power Connection

We recommend grounding the motor housing.

Power connection diagram.

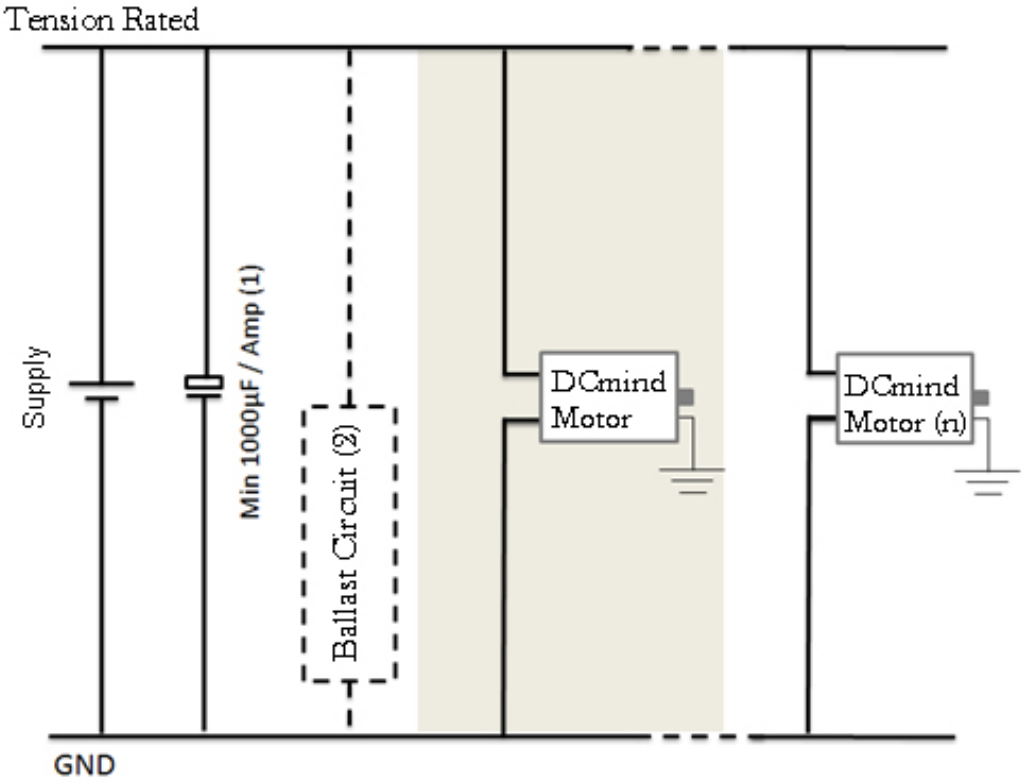


Figure 4

(1) Include capacitors to smooth out inrush currents. Recommended value 1000 µF/A drawn.
(2) Optional. The ballast circuit eliminates voltage surges produced when braking. See next section.

The product is not protected against polarity reversals on the power cable.
A polarity reversal can damage the product irreversibly.

9.1.1. Ballast Circuit

When the motor brakes, the kinetic energy stored in the inertias during rotation is returned to the power supply and generates a voltage surge. This voltage surge can be destructive for the motor or for devices connected to the power supply.
In the event of frequent braking, **an external ballast circuit must be used**.
It is always necessary to conduct tests to check what size it should be.

9.1.1.1. Proposed Ballast Circuit Diagram

The diagram below allows the braking energy to be dissipated into a resistor, thus limiting voltage surges at the motor terminals.

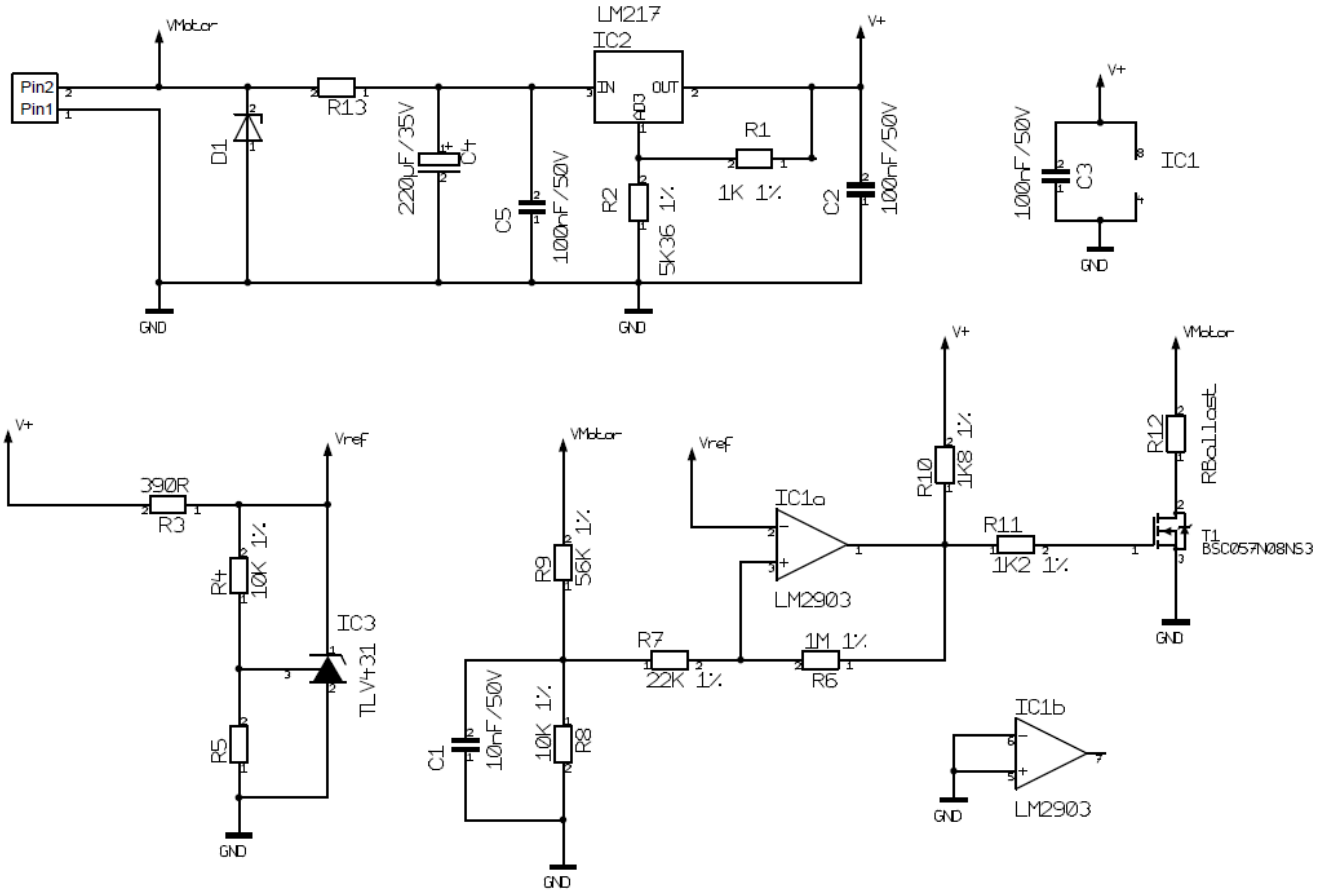


Figure 5

9.1.1.2. Determining the Size of the R12 Resistor ($R_{Ballast}$)

The higher the braking current, the lower the resistor value. Typical values are around several Ohms.
With V the rotation speed in revolutions per minute and J the inertia in Kg.m², the energy E in Joules stored in the inertia is given by:

It should be noted however that this is a simplified and somewhat pessimistic calculation since it does not take account of the energy stored in the capacitors, nor that lost during friction, the gearbox, etc.

9.1.1.3. Voltage Breaking Capacity Selection

The voltage breaking capacity should be selected:

- Depending on the power supply
- Depending on the other devices connected to this power supply

If your power supply does not tolerate current feedback, place a diode in series upstream of the ballast circuit to protect it.

The voltage breaking capacity usually selected is between +10% and +20% of the supply voltage.
E.g.: For 24 VDC the voltage breaking capacity would be 28 VDC.

List of components for the usual operating voltages:

Nominal voltage	12V	24V	32V	48V
Voltage breaking capacity	14V	28V	36V	52V
D1	SMBJ14A	SMBJ28A	SMBJ36A	SMBJ54A
R13	0R	560R 0.5W	1K 1W	2K2 2W
R5	15K 1%	4K32 1%	3K09 1%	1K95 1%

9.1.2. EMC Protection

In order to ensure that the product is compatible with EMC standards IEC 61000-6-1, IEC 61000-6-2, IEC 61000-6-3, IEC 61000-6-4, we recommend:

- Connecting the motor to ground while limiting length of the grounding strip,
- Adding capacitors on the main power supply.
  We recommend 1000 µF per amp drawn.

9.2. Protection

DANGER

PROTECTION
The product has internal protection devices that switch off the motor power supply when activated. As the motor is no longer controlled, driving loads can decrease.
• The system manufacturer is responsible for complying with all the applicable safety rules in the event of product failure.
Failure to comply with these precautions will result in death or serious injury.

9.2.1. Voltage Protection

The product incorporates protection against voltage surges and undervoltages.

Protection against voltage surges:
The voltage surge threshold can be set in the HMI between 12 and 57 V (set at 57 V by default).
When the supply voltage exceeds the threshold, the product automatically switches to ERROR mode. In ERROR mode the motor is no longer controlled.
To reset the motor:

- The supply voltage must be at least 1 V below the threshold value.
- The motor inputs must be set to STOP mode.

Protection against undervoltages:
When the supply voltage falls below 8 V, the product automatically switches to ERROR mode. In ERROR mode the motor is no longer controlled.
To reset the motor:

- The supply voltage must be higher than 9 V.
- The motor inputs must be set to STOP mode.

9.2.2. Temperature Protection

The product incorporates temperature protection in the form of a temperature sensor on the motor pilot control card.

Temperature protection:
When the internal temperature exceeds 110°C, the product automatically switches to ERROR mode. In ERROR mode the motor is no longer controlled.
To reset the motor:

- The temperature must be less than 90°C.
- The motor inputs must be set to STOP mode.

9.2.3. Current Limiting

The product incorporates internal current limiting. This limiting directly affects the motor in terms of hardware. This limiting automatically restricts the current to 17 A in the motor phases.
If this limit is reached, it results in a loss of motor performance.

This product is not designed to operate continuously with this limiting (see the "Electrical Data" section).

9.3. USB Connection

USB connection requires a type B micro-USB socket on the motor.

The cable must be less than 3 m long.

Possible cable part number: MOLEX 68784-0003.

Connection procedure

- Carefully remove the black stopper from the motor to reveal the Micro USB-B connector. The stopper has a retainer to keep it attached to the motor.

Figure 6

Figure 7

- Insert the USB cable and install the drivers as instructed.

Take care never to touch the connector or contacts inside the motor with your fingers or any inappropriate object.

Once finished, it is essential to replace the stopper carefully, to maintain the motor seal and protect the connector from any contact.

Simply pressing your finger in the middle of the stopper will close it properly.

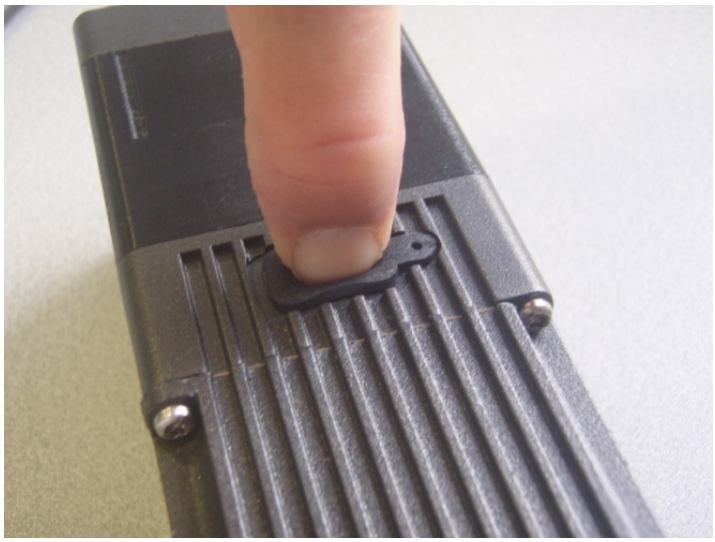


Figure 8

Incorrect stopper fitting

Figure 9

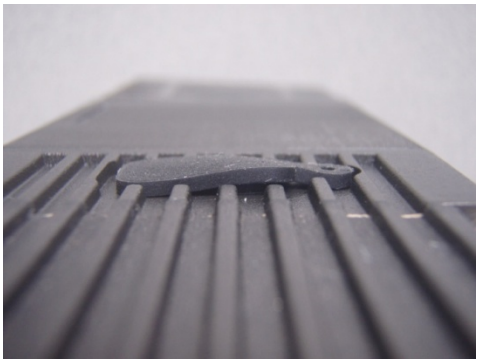


Figure 10

Correct stopper fitting

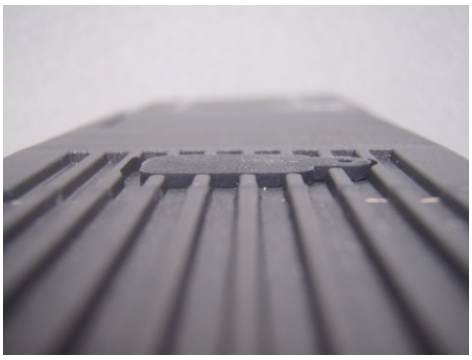


Figure 11

Figure 12

9.4. Input/Output Connection

9.4.1. Equivalent Input Diagram

NPN digital inputs

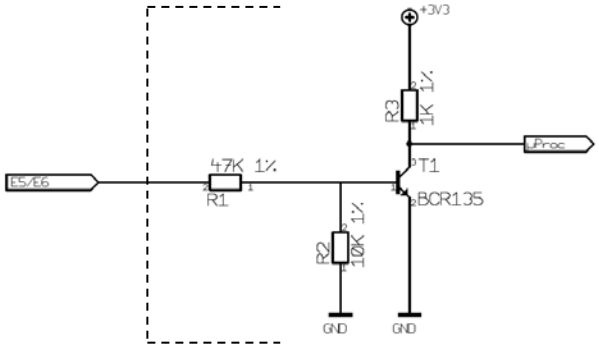


Figure 13

Analog/PWM/digital inputs

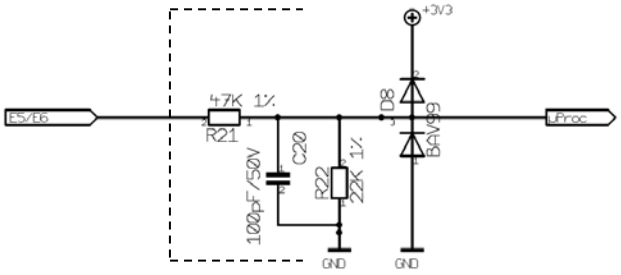


Figure 14

9.4.2. Equivalent Output Diagram

PNP outputs with max. 50 mA open collector.
Include a pull down resistor (recommended value 4.7 kΩ).

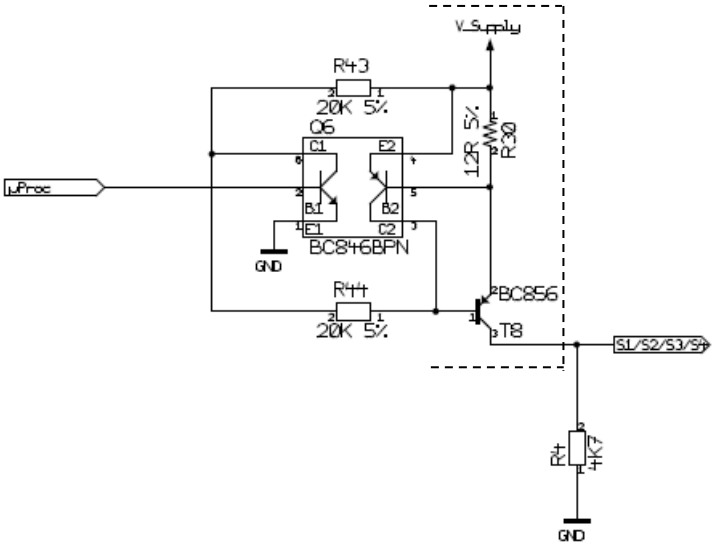
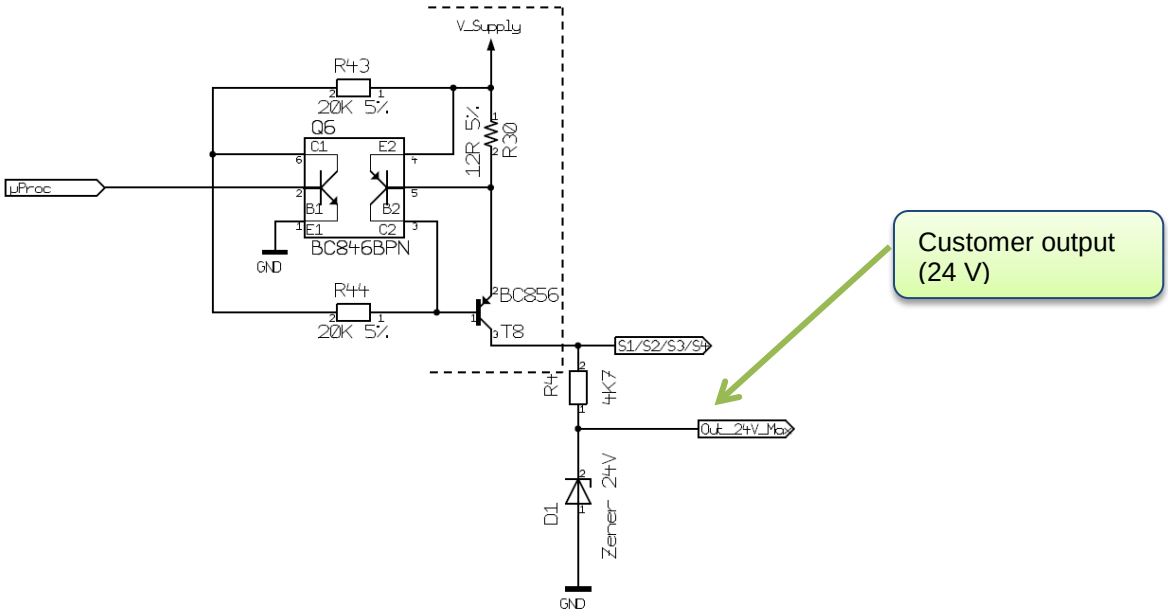


Figure 15

Caution: The output level is the same as the motor supply voltage:
if V DC = 48V then Out1/Out2/Out3/Out4 = 48 V.
In the event of rejection, this voltage increases accordingly, and can rise up to 57 V maximum (voltage threshold value).

If your application necessitates limiting the voltage value of these outputs, implement the diagram below.



10. INSTALLATION OF THE DCMIND-SOFT HMI

10.1. Introduction

To configure motors in the SMI21 DCmind Brushless range, Crouzet provides a user-friendly HMI that is easy to use. By means of a communication interface, the HMI establishes the connection between the PC and the motor and can be used to configure the motor and adapt its operation to the application.

10.2. System Required

The HMI is compatible with the following operating systems:

- Windows XP Family & Professional (with Framework version 3.5 minimum: supplied on USB stick)
- Windows Vista
- Windows 7 (32 & 64-bit)

The HMI installation files are supplied on the USB stick in the programming kit and are available for download from the Internet at the following address: http://www.crouzet.com/

10.3. Installation of the USB Drivers

Run the "*Driver Motor.exe*" file in the "Driver" folder:

USB-to-Serial Device Driver Installer
Crouzet
Welcome to the USB-to-Serial Device Driver Installer!
This wizard will walk you through installing the driver for the USB-to-Serial Device.
To continue, click Next.
< Back
Next >
Cancel

Figure 16

USB-to-Serial Device Driver Installer
Crouzet
Congratulations! You are finished installing the device driver.
The drivers were successfully installed on this computer.
You can now connect your device to this computer. If your device came with instructions, please read them first.
Driver Name
Status
Microchip Technology, I...
Ready to use
< Back
Finish
Cancel

Figure 17

10.4. Installation of the Crouzet DCmind-Soft HMI

Run the "Setup_DCmind_Soft_Vxxx.msi" file and follow the instructions:

N.B.: - When installing the "DCmind-Soft" HMI, check that Bluetooth is disabled on the PC.

- The USB drivers must always be installed upstream.

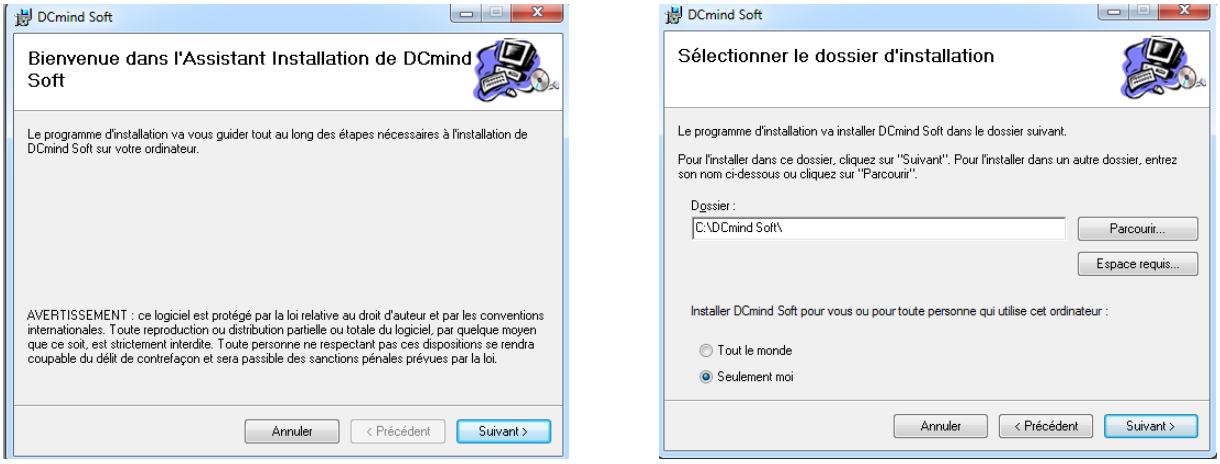

DCmind Soft
Bienvenue dans l'Assistant Installation de DCmind Soft
Le programme d'installation va vous guider tout au long des étapes nécessaires à l'installation de DCmind Soft sur votre ordinateur.
AVERTISSEMENT : ce logiciel est protégé par la loi relative au droit d'auteur et par les conventions internationales. Toute reproduction ou distribution partielle ou totale du logiciel, par quelque moyen que ce soit, est strictement interdite. Toute personne ne respectant pas ces dispositions se rendra coupable du délit de contrefaçon et sera passible des sanctions pénales prévues par la loi.
Annuler
< Précédent
Suivant >
DCmind Soft
Sélectionner le dossier d'installation
Le programme d'installation va installer DCmind Soft dans le dossier suivant.
Pour l'installer dans ce dossier, cliquez sur "Suivant". Pour l'installer dans un autre dossier, entrez son nom ci-dessous ou cliquez sur "Parcourir".
Dossier :
C:\DCmind Soft\
Parcourir...
Espace requis...
Installer DCmind Soft pour vous ou pour toute personne qui utilise cet ordinateur :
Tout le monde
Seulement moi
Annuler
< Précédent
Suivant >

Figure 18: Steps 1 and 2

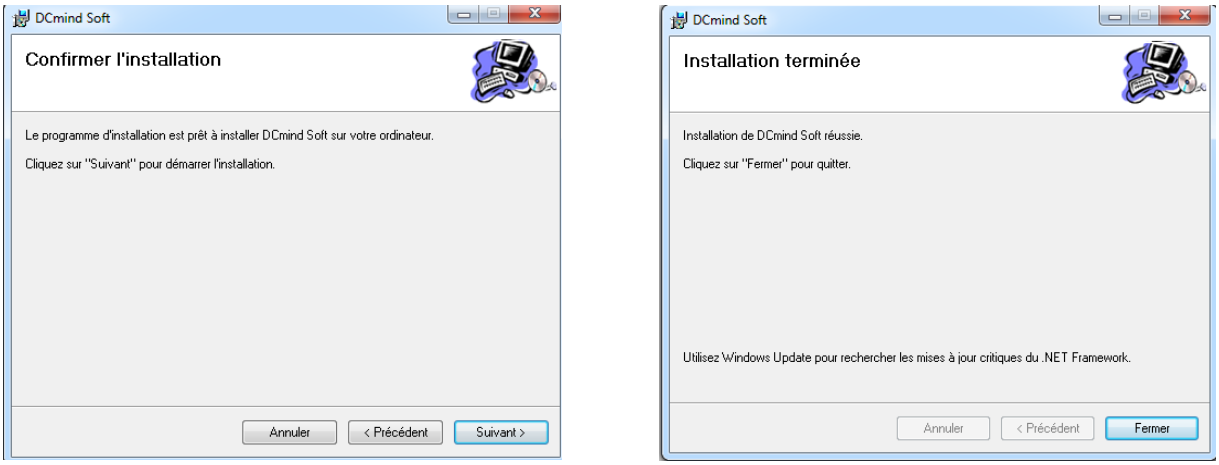

DCmind Soft
Confirmer l'installation
Le programme d'installation est prêt à installer DCmind Soft sur votre ordinateur.
Cliquez sur "Suivant" pour démarrer l'installation.
Annuler
< Précédent
Suivant >
DCmind Soft
Installation terminée
Installation de DCmind Soft réussie.
Cliquez sur "Fermer" pour quitter.
Utilisez Windows Update pour rechercher les mises à jour critiques du .NET Framework.
Annuler
< Précédent
Fermer

Figure 19: Steps 3 and 4

Once installation is complete, the PC software can be launched directly via the "DCmind-Soft" icon on the desktop.

Note: To uninstall the "DCmind-Soft" application, follow the standard Windows procedure:

- "*Start*"
- "*Control Panel*"
- "*Add or Remove Programs*"
- "*DCmind-Soft*"
- "*Remove*"

Note: For PCs running Windows XP, the version of Framework may not be recent enough to be able to install the "DCmind-Soft" HMI. On launching the setup, the HMI automatically informs the user of this problem by displaying the following window:

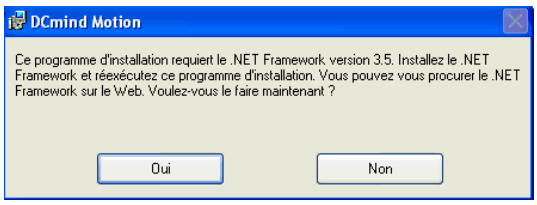

DCmind Motion
Ce programme d'installation requiert le .NET Framework version 3.5. Installez le .NET Framework et réexécutez ce programme d'installation. Vous pouvez vous procurer le .NET Framework sur le Web. Voulez-vous le faire maintenant ?
Oui
Non

Figure 20

We recommend that you download the latest available version of Framework from the Microsoft website. Should no internet connection be available, a minimum version of Framework is supplied on the USB stick in the programming kit.

To install version 3.5 of Framework supplied on the USB stick, run the "dotnetfx35.exe" file and follow the instructions:

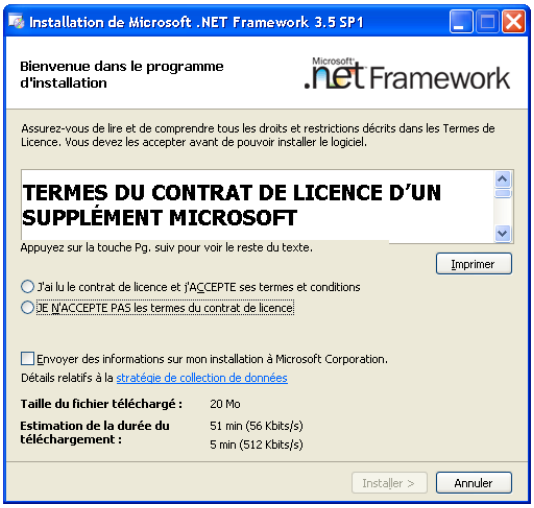

Installation de Microsoft .NET Framework 3.5 SP1
Bienvenue dans le programme d'installation
Microsoft .net Framework
Assurez-vous de lire et de comprendre tous les droits et restrictions décrits dans les Termes de Licence. Vous devez les accepter avant de pouvoir installer le logiciel.
TERMES DU CONTRAT DE LICENCE D'UN SUPPLÉMENT MICROSOFT
Appuyez sur la touche Pg. suiv pour voir le reste du texte.
Imprimer
J'ai lu le contrat de licence et j'ACCEPTE ses termes et conditions
JE N'ACCEPTE PAS les termes du contrat de licence
Envoyer des informations sur mon installation à Microsoft Corporation.
Détails relatifs à la stratégie de collection de données
Taille du fichier téléchargé : 20 Mo
Estimation de la durée du téléchargement : 51 min (56 Kbits/s) 5 min (512 Kbits/s)
Installer >
Annuler

Figure 21

Tick the box "I have read and accept the license terms", then press the "Install >" button.

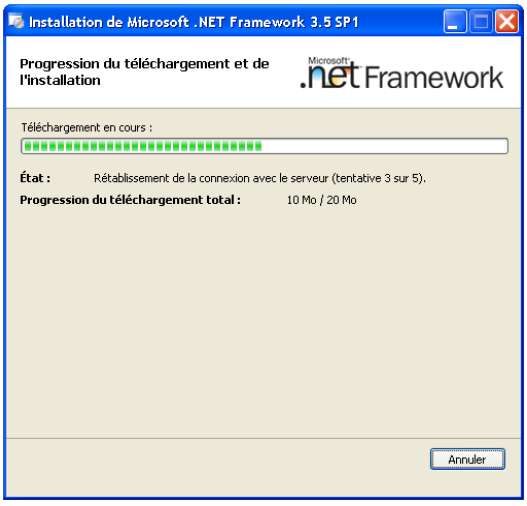

Installation de Microsoft .NET Framework 3.5 SP1
Progression du téléchargement et de l'installation
Microsoft .net Framework
Téléchargement en cours :
État : Rétablissement de la connexion avec le serveur (tentative 3 sur 5).
Progression du téléchargement total : 10 Mo / 20 Mo
Annuler

Figure 22

During installation, Windows tries to connect to the server to download the Framework multi-language package (this may take several minutes as 5 attempts are made to connect to the server). After 5 attempts, the software is installed directly via the setup supplied on the USB stick:

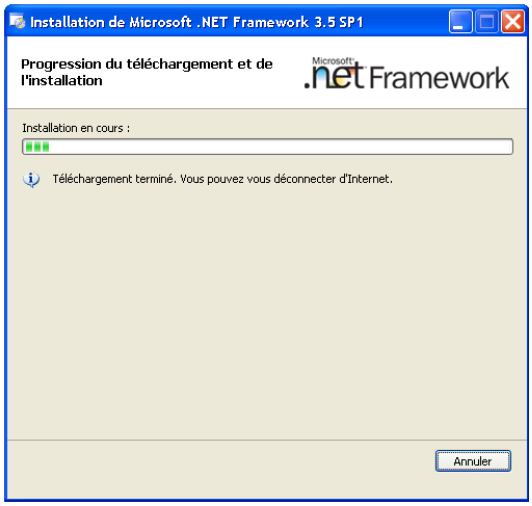

Installation de Microsoft .NET Framework 3.5 SP1
Progression du téléchargement et de l'installation
Microsoft .net Framework
Installation en cours :
Téléchargement terminé. Vous pouvez vous déconnecter d'Internet.
Annuler

Figure 23

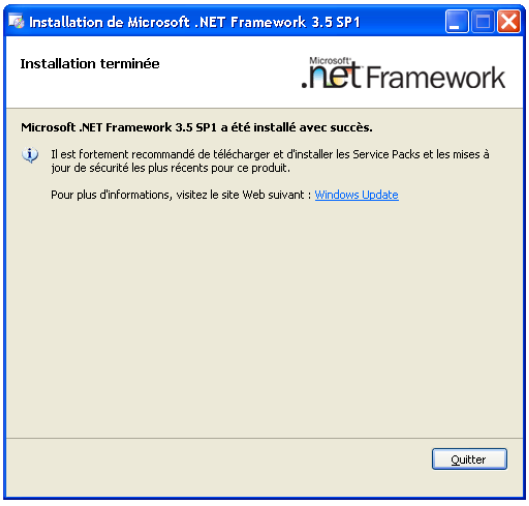

Installation de Microsoft .NET Framework 3.5 SP1
Installation terminée
Microsoft .net Framework
Microsoft .NET Framework 3.5 SP1 a été installé avec succès.
Il est fortement recommandé de télécharger et d'installer les Service Packs et les mises à jour de sécurité les plus récents pour ce produit.
Pour plus d'informations, visitez le site Web suivant : Windows Update
Quitter

Figure 24

Once installation of Framework 3.5 is complete, try again to install the "DCmind-Soft" HMI, referring to the "Installation of the Crouzet DCmind-Soft HMI" section in this document.

10.5. Description of the Main Window

Once all the installations are complete (drivers + HMI), connect the motor to the PC and launch the HMI by double-clicking on the icon below:

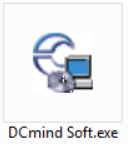


Figure 25

The HMI home page appears:

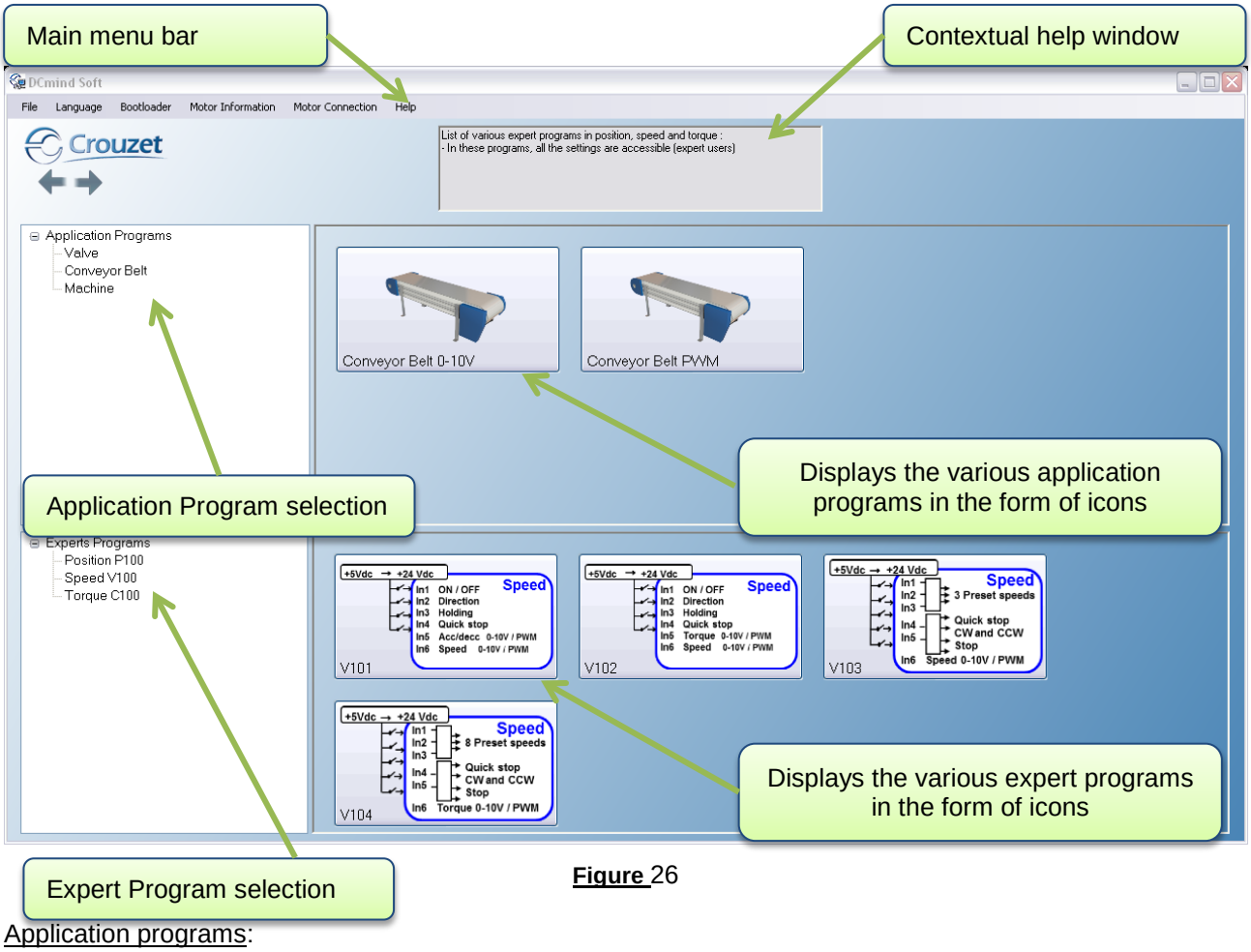


Figure 26

Application programs:

- The application programs are grouped together with similar applications (valve, conveyor belt, machine, etc.).
- They enable quick start-up with completion of just a few key application values.
- Each application program is based on a preconfigured expert program. After testing the motor a few times in the application, the user can refine the motor operation by accessing all the adjustment parameters via the expert program linked to the application program and changing the pre-filled values.

Expert programs:

- The expert programs are grouped together with similar programs (P1xx, P2xx, etc position control, V1xx, V2xx speed control, C1xx, C2xx torque control).
- These are generic programs, not specific to any application. They can be used to access all the options and settings.
- They can be used directly, without going via the "application program" step and they offer a wider choice of uses.

The contextual help window gives a description of the selected application when you hover over it with the mouse cursor.

Note: DCmind-Soft is constantly being improved. The latest available update can be downloaded from our website http://www.crouzet.com/

Description of the tabs on the main menu bar:

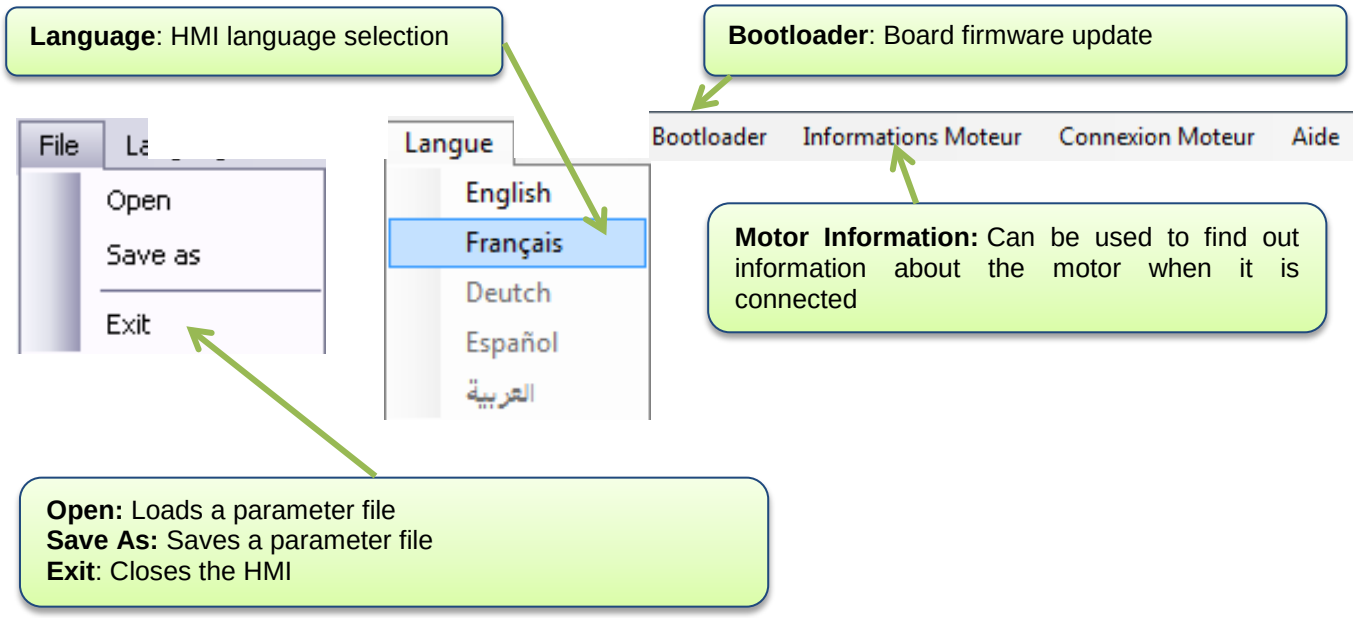


Figure 27

"Motor Information" window

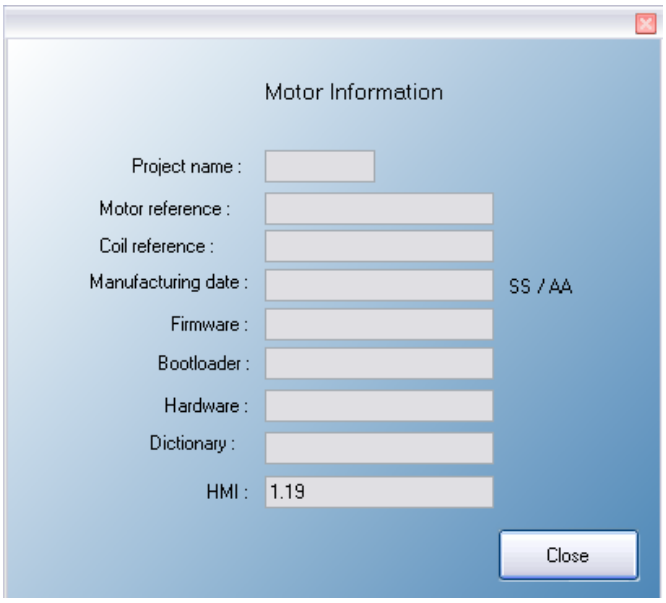


Figure 28

The "Help" tab contains the SMI21 DCmind Brushless motors user manual in .pdf format.

10.6. Motor Connection

To connect the motor, link the motor and the PC using the USB B to USB A micro cable (supplied in the programming kit), power up the motor and click on "Motor Connection" in the main menu bar. The following window appears:

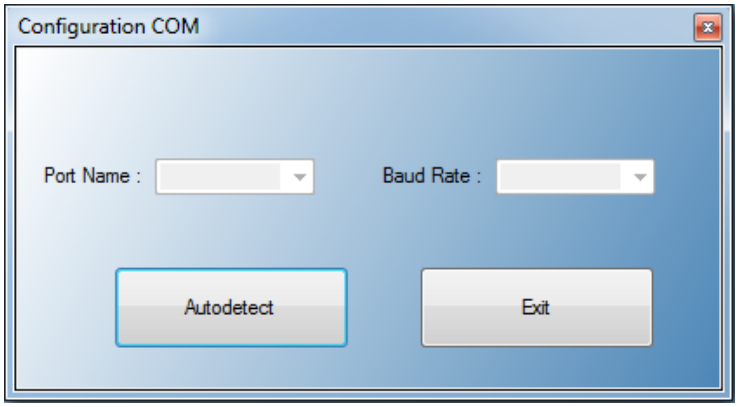


Figure 29

Click the "Autodetect button to start the automatic motor search. If a motor is connected to the PC, it is automatically detected and the following window appears:

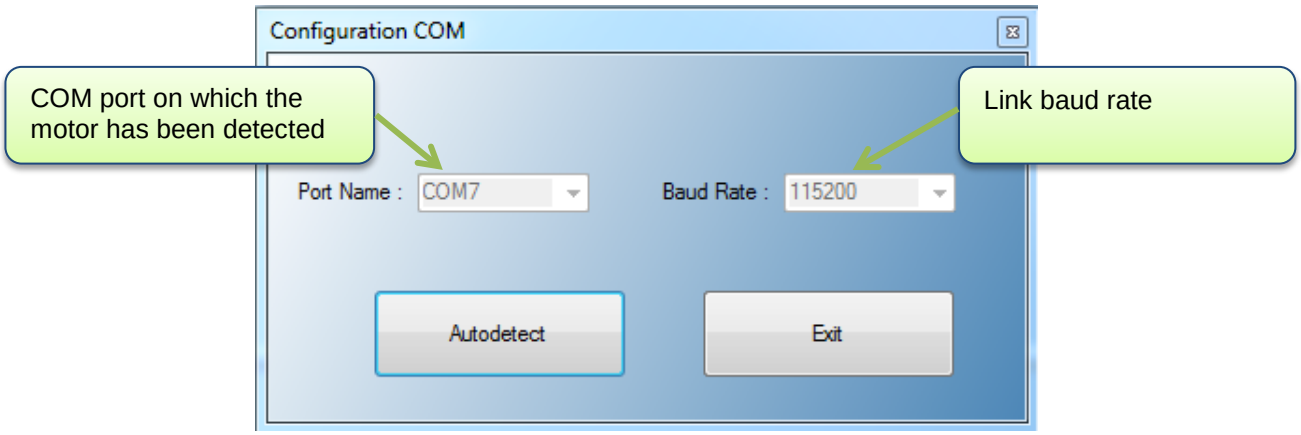


Figure 30

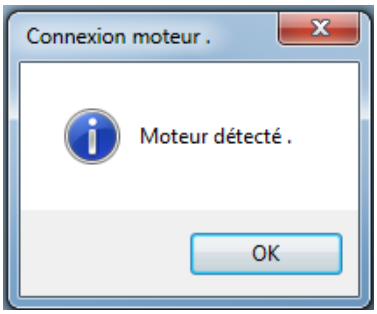


Figure 31

Click "OK", the motor is now connected and ready to be used.

If "Motor not detected" appears in the information window, check that the motor is correctly supplied with power, the micro USB B to USB A cable is plugged in correctly and repeat the procedure.

10.7. Updating the Firmware

To update the version of the software embedded in the motor, a bootloader is used via USB communication. This operation can only be performed by advanced users, as if done incorrectly this could result in the product not working.

Power up the motor and click "Bootloader" in the main menu bar (entire memory completely rewritten), the following window appears:

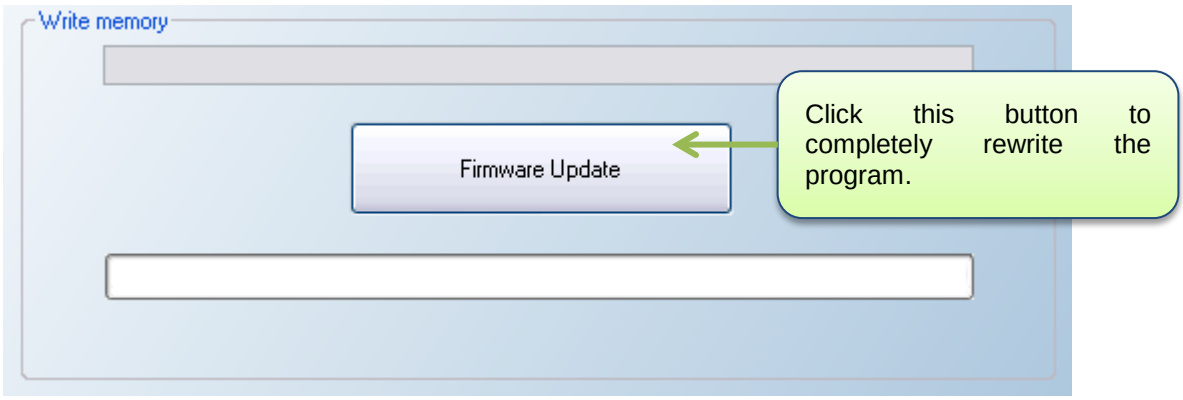


Figure 32

A warning message appears asking to confirm the firmware update request and to avoid any incorrect action:

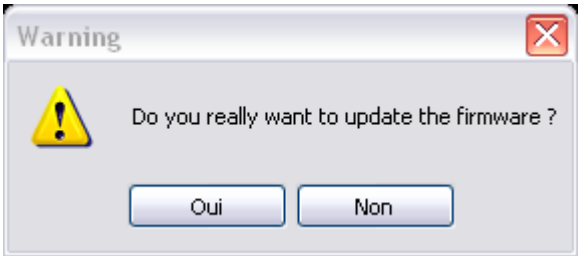


Figure 33

To start the update, click "Yes" and select the .hex program supplied by CROUZET:

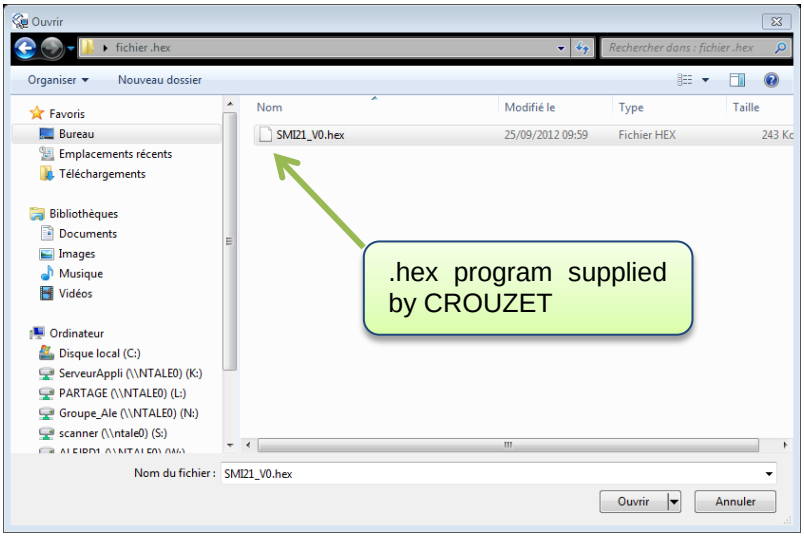


Figure 34

Click the "Open" button, updating begins:

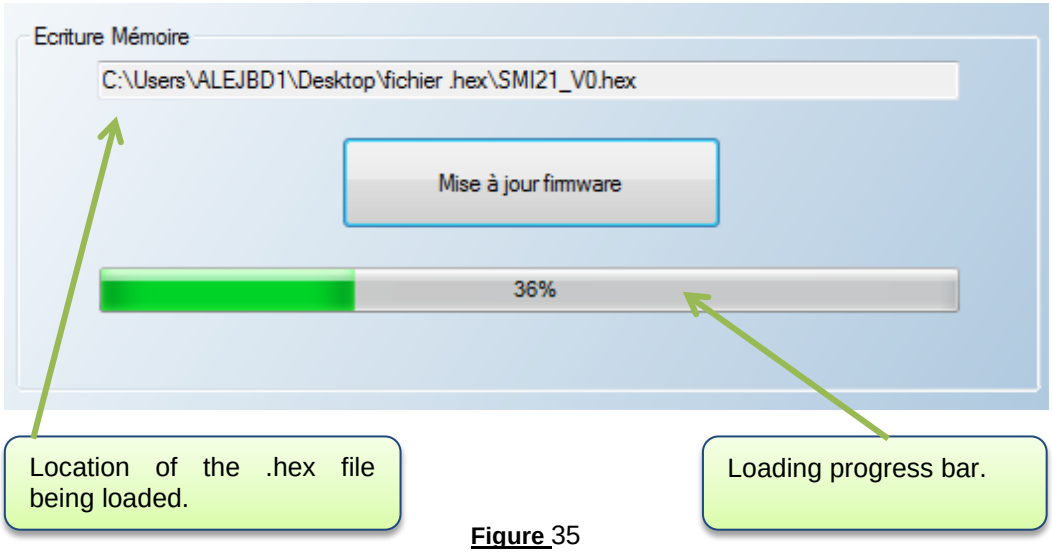


Figure 35

When the update is complete, the following window appears, meaning that loading has been successful:

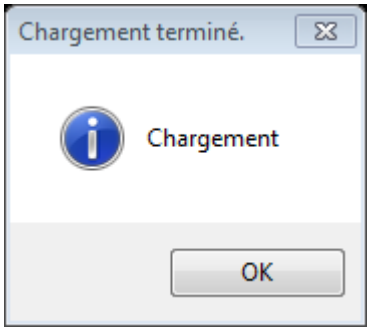


Figure 36

11. APPLICATION PROGRAMS

11.1. Description

Select an application group from the list of application programs, then one of the icons corresponding to your application.

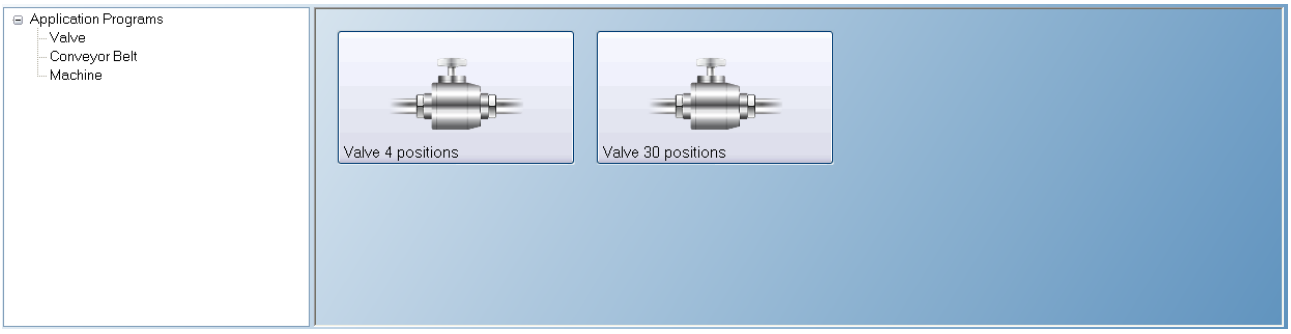


Figure 37

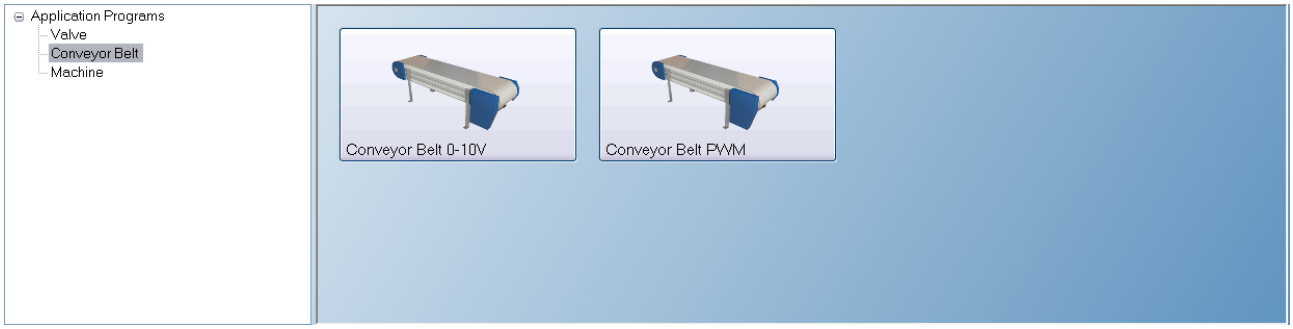


Figure 38

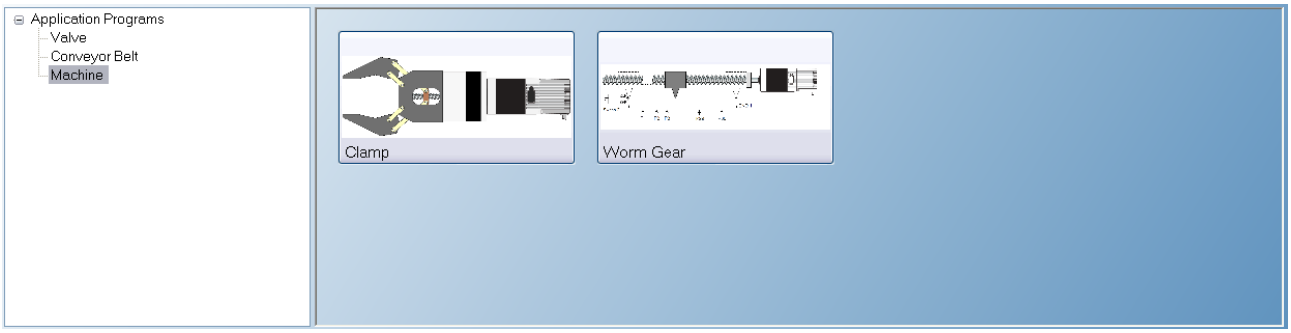
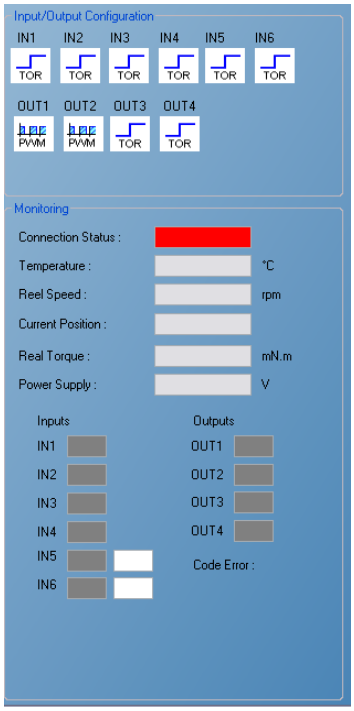


Figure 39

11.2. Description of the Monitoring Part

The monitoring part of the HMI is common to all the expert and application program tabs.



This zone uses graphic icons to indicate the type of program I/O used (in this case 4 digital inputs, 2 analog setpoint inputs, 2 PWM outputs and 2 digital outputs).

This zone describes the status of the connection between the HMI and the motor (green for connected and red for not connected).It gives in real time (once a second) the value of the various measurements taken on the motor (voltage, temperature, speed, position and torque).

States of the various program digital I/O (green for active and blue for inactive).
For the analog setpoints, the user can display their value (rpm, rpm/sec, mN.m, etc.) on the IN5 and IN6 dial faces.
The type of error detected can be viewed on this tab.
PWM/Pulse or Frequency type outputs are not included in this tab.

Figure 40

11.3. "Valve" Group

11.3.1. "Valve 4 positions" Application Program

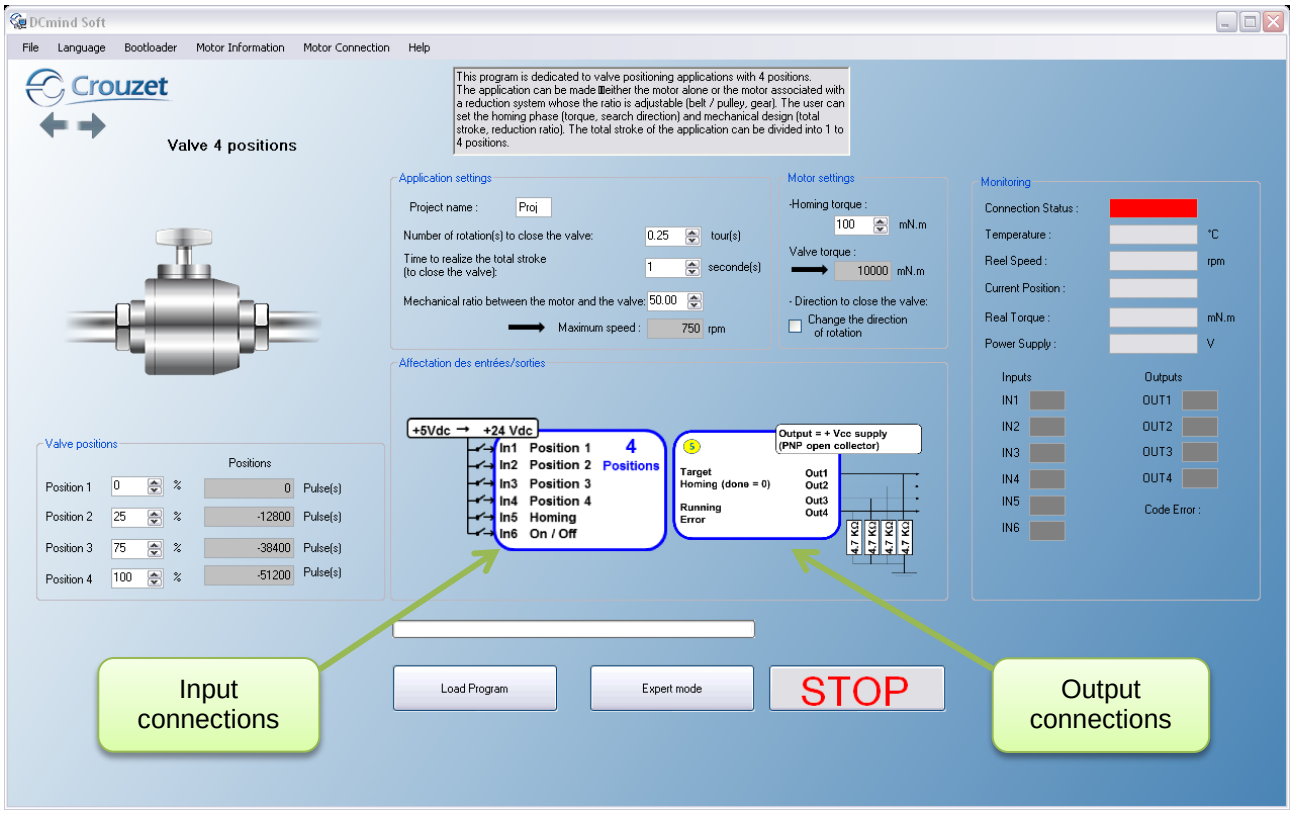


Figure 41

The "Valve 4 positions" application program invokes the P101 expert program.
The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.
The values preset in application mode will be loaded directly in expert mode.
It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.
To restart the motor, the program needs to be reloaded.
Once the settings are complete, press the "Load Program" button to configure the motor.

11.3.1.1. Inputs/Outputs Configuration

Refer to the "I/O Connection" section.

Inputs:

- IN1: If 0 → No position setpoint, if 1 → Setpoint = "Position 1" Parameter
- IN2: If 0 → No position setpoint, if 1 → Setpoint = "Position 2" Parameter
- IN3: If 0 → No position setpoint, if 1 → Setpoint = "Position 3" Parameter
- IN4: If 0 → No position setpoint, if 1 → Setpoint = "Position 4" Parameter
- IN5: If 0 → No action, if 1 → Launch homing phase
- IN6: If 0 → Stop, if 1 → Run

N.B.: if more than 1 input IN1 to IN4 is activated at the same time, the motor switches to stop mode.

Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: If 0 → setpoint position not reached, if 1 → setpoint position reached.
- OUT2: If 0 → homing phase complete, if 1 → homing phase in progress or not performed.
- OUT3: If 0 → motor stopped, if 1 → motor running.
- OUT4: If 0 → no error, if 1 → error detected.

11.3.1.2. Application Settings

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default. For more details, see the "Saving Parameters" paragraph.
- The "Number of rotation(s) to close the valve" and "Mechanical ratio between the motor and the valve" parameters are used to calculate the application total stroke in number of motor revolutions:

- For information, all 4 positions are given in number of pulses (4096 pulses per motor revolution) in the grayed-out boxes.

11.3.2. "Valve 30 positions" Application Program with 1 Mechanical Stop

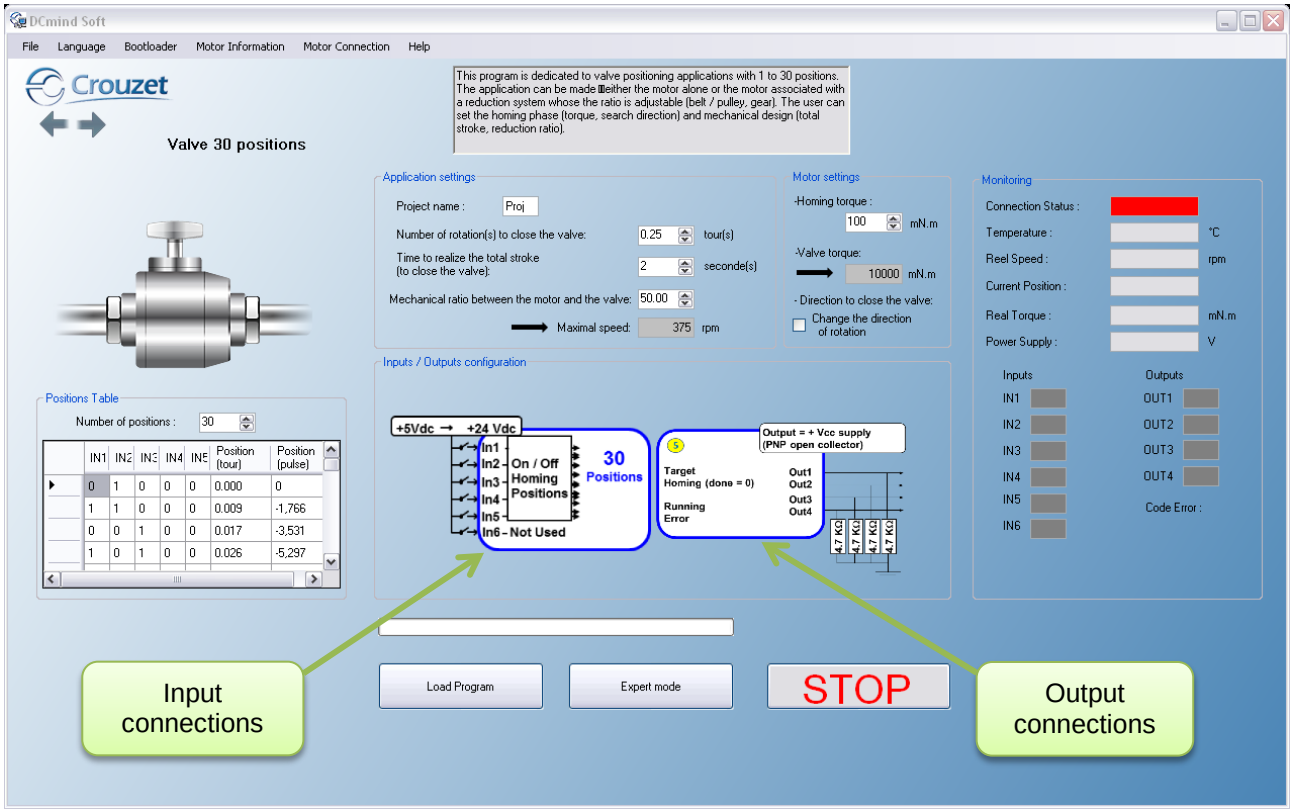


Figure 42

The "Valve 30 positions" application program invokes the P111 expert program.
The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.
The values preset in application mode will be loaded directly in expert mode.
It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.
To restart the motor, the program needs to be reloaded.
Once the settings are complete, press the "Load Program" button to configure the motor.

11.3.2.1. Inputs/Outputs Configuration

Refer to the "I/O Connection" section.

Inputs:

- IN1 to IN5: 32 possible combinations:
  - IN1 = IN2 = IN3 = IN4 = IN5 = 0 → Stop.
  - IN1 = 1, all 4 others = 0 → Launch homing phase.
  - The other 30 combinations correspond to the 30 position setpoints.
- IN6: Not used.

Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: If 0 → setpoint position not reached, if 1 → setpoint position reached.
- OUT2: If 0 → homing phase complete, if 1 → homing phase in progress or not performed.

- OUT3: If 0 → motor stopped, if 1 → motor running.
- OUT4: If 0 → no error, if 1 → error detected.

11.3.2.2. Application Settings

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default. For more details, see the "Saving Parameters" paragraph.
- The "Number of rotation(s) to close the valve" and "Mechanical ratio between the motor and the valve" parameters are used to calculate the application total stroke in number of motor revolutions:

11.4. "Conveyor Belt" Group

11.4.1. "Conveyor Belt 0-10V" Application Program

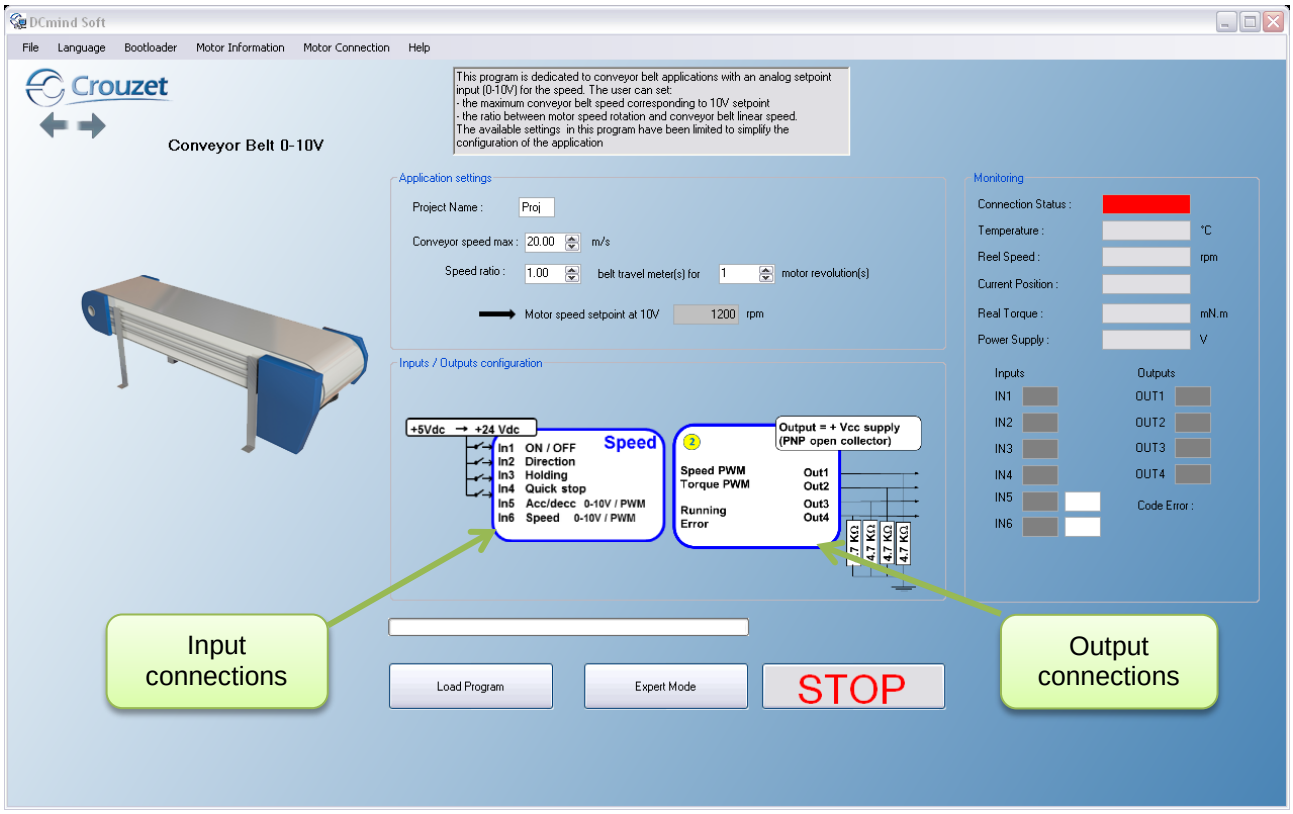


Figure 43

The "Conveyor Belt 0-10V" application program invokes the V101 expert program.
The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.
The values preset in application mode will be loaded directly in expert mode.
It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.
To restart the motor, the program needs to be reloaded.

Once the settings are complete, press the "Load Program" button to configure the motor.

11.4.1.1. Inputs/Outputs Configuration

Refer to the "I/O Connection" section.

Inputs:

- IN1: If 0 → Stop, if 1 → Run
- IN2: If 0 → motor running in reverse (CCW), if 1 → motor running forward (CW)
- IN3: If IN3 = 1 and IN1 = 1 and IN6 = 0, application of a 150 mNm holding torque.
- IN4: If 0 → no action, if 1 → Quick start by short-circuiting the coils. This action takes priority over the other commands.
- IN5: 0-10 V control. Sets the motor acceleration and deceleration. 40,000 rpm/sec for 0 V (maximum acceleration) and 100 rpm/sec for 10 V.

- IN6: 0-10 V control. Sets the speed setpoint. 0 V for 0 rpm and 10 V for the maximum motor speed defined by the user.

Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: Provides information on the motor speed value in PWM.
  Cyclical ratio = 0% → speed = 0 rpm
  Cyclical ratio = 100% → speed = maximum speed.
- OUT2: Provides information on the real torque value in PWM.
  Cyclical ratio = 0% → torque = 0 mNm
  Cyclical ratio = 100% → torque = 1 Nm.
- OUT3: If 0 → motor running, if 1 → motor stopped.
- OUT4: If 0 → error detected, if 1 → no error.

11.4.1.2. Application Settings

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default. For more details, see the "Saving Parameters" paragraph.
- The maximum motor speed corresponding to a voltage of 10 V is calculated as follows:

11.4.2. "Conveyor Belt PWM" Application Program

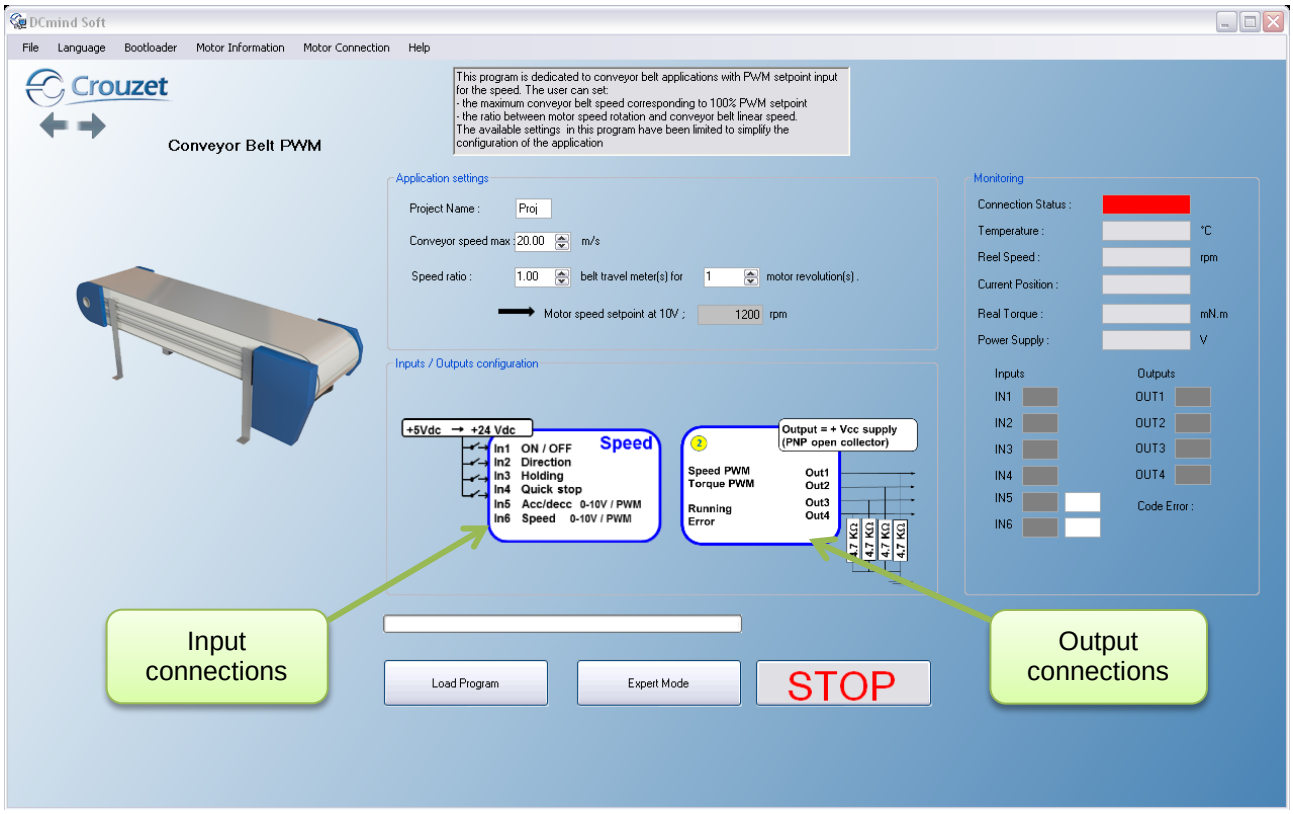


Figure 44

The "Conveyor Belt PWM" application program invokes the V101 expert program.
The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.
The values preset in application mode will be loaded directly in expert mode.
It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.
To restart the motor, the program needs to be reloaded.

Once the settings are complete, press the "Load Program" button to configure the motor.

11.4.2.1. Inputs/Outputs Configuration

Refer to the "I/O Connection" section.

Inputs:

- IN1: If 0 → Stop, if 1 → Run
- IN2: If 0 → motor running in reverse (CCW), if 1 → motor running forward (CW)
- IN3: If IN3 = 1 and IN1 = 1 and IN6 = 0, application of a 150 mNm holding torque.
- IN4: If 0 → no action, if 1 → Quick start by short-circuiting the coils. This action takes priority over the other commands.
- IN5: PWM control. Sets the motor acceleration and deceleration. 40,000 rpm/sec for 0% PWM (maximum acceleration) and 100 rpm/sec for 100% PWM.
- IN6: PWM control. Sets the speed setpoint. 0% PWM for 0 rpm and 100% PWM for the maximum motor speed defined by the user.

Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: Provides information on the motor speed value in PWM.
  Cyclical ratio = 0% → speed = 0 rpm
  Cyclical ratio = 100% → speed = maximum speed.
- OUT2: Provides information on the real torque value in PWM.
  Cyclical ratio = 0% → torque = 0 mNm
  Cyclical ratio = 100% → torque = 1 Nm.
- OUT3: If 0 → motor running, if 1 → motor stopped.
- OUT4: If 0 → error detected, if 1 → no error.

11.4.2.2. Application Settings

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default. For more details, see the "Saving Parameters" paragraph.
- The maximum motor speed corresponding to a PWM signal with 100% cyclical ratio is calculated as follows:

11.5. "Machine" Group

11.5.1. "Worm Gear" Application Program

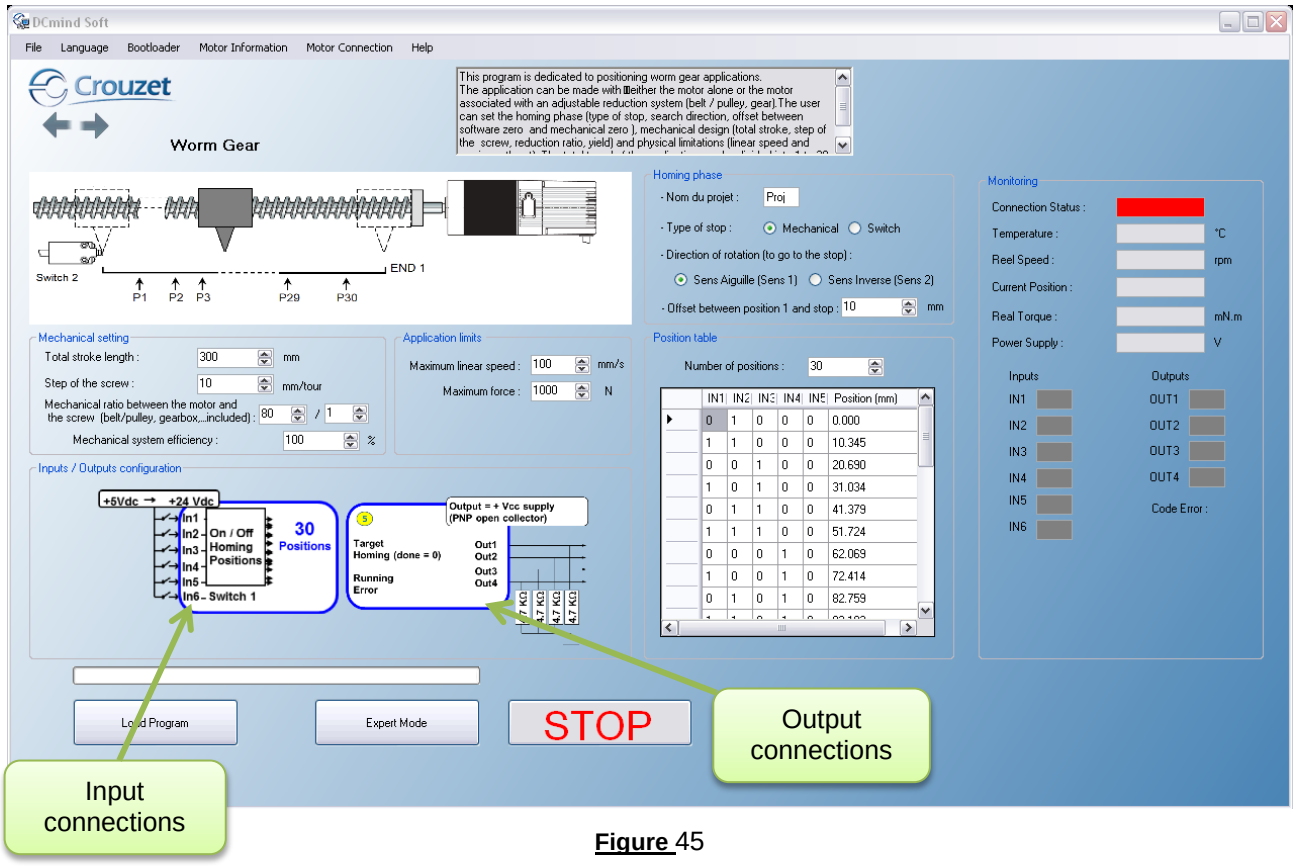

DCmind Soft
File Language Bootloader Motor Information Motor Connection Help
Crouzet
Worm Gear
This program is dedicated to positioning worm gear applications.
The application can be made with either the motor alone or the motor associated with an adjustable reduction system (belt / pulley, gear).The user can set the homing phase (type of stop, search direction, offset between software zero and mechanical zero), mechanical design (total stroke, step of the screw, reduction ratio, yield) and physical limitations (linear speed and
Switch 2
END 1
P1 P2 P3 P29 P30
Homing phase
· Nom du projet : Proj
· Type of stop : Mechanical Switch
· Direction of rotation (to go to the stop) :
Sens Aiguille (Sens 1) Sens Inverse (Sens 2)
· Offset between position 1 and stop : 10 mm
Monitoring
Connection Status :
Temperature : °C
Reel Speed : rpm
Current Position :
Real Torque : mN.m
Power Supply : V
Inputs
IN1 IN2 IN3 IN4 IN5 IN6
Outputs
OUT1 OUT2 OUT3 OUT4
Code Error :
Mechanical setting
Total stroke length : 300 mm
Step of the screw : 10 mm/tour
Mechanical ratio between the motor and the screw (belt/pulley, gearbox,...included) : 80 / 1
Mechanical system efficiency : 100 %
Application limits
Maximum linear speed : 100 mm/s
Maximum force : 1000 N
Position table
Number of positions : 30
IN1 IN2 IN3 IN4 IN5 Position (mm)
0 1 0 0 0 0.000
1 1 0 0 0 10.345
0 0 1 0 0 20.690
1 0 1 0 0 31.034
0 1 1 0 0 41.379
1 1 1 0 0 51.724
0 0 0 1 0 62.069
1 0 0 1 0 72.414
0 1 0 1 0 82.759
Inputs / Outputs configuration
+5Vdc → +24 Vdc
In1
In2
In3
In4
In5
In6 - Switch 1
On / Off Homing Positions
30 Positions
Output = + Vcc supply (PNP open collector)
Target Homing (done = 0)
Running
Error
Out1
Out2
Out3
Out4
4.7 KΩ
Load Program
Expert Mode
STOP
Output connections
Input connections

Figure 45

The "Worm Gear" application program invokes the P111 expert program.
The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.
The values preset in application mode will be loaded directly in expert mode.
It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.
To restart the motor, the program needs to be reloaded.
Once the settings are complete, press the "Load Program" button to configure the motor.

11.5.1.1. Inputs/Outputs Configuration

Refer to the "I/O Connection" section.

Inputs:

- IN1 to IN5: 32 possible combinations:
  - IN1 = IN2 = IN3 = IN4 = IN5 = 0 → Stop
  - IN1 = 1, all 4 others = 0 → Launch homing phase
  - The other 30 combinations correspond to the 30 position setpoints
- IN6: Switch or unused (if mechanical stop selected).

Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: If 0 → setpoint position not reached, if 1 → setpoint position reached.
- OUT2: If 0 → homing phase complete, if 1 → homing phase in progress or not performed.
- OUT3: If 0 → motor stopped, if 1 → motor running.
- OUT4: If 0 → no error, if 1 → error detected.

11.5.1.2. Initialization Phase

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default. For more details, see the "Saving Parameters" paragraph.
- Select the type of stop, either "Mechanical" if the stop is achieved by detection of an obstacle on the application, or "Switch" if a limit switch is used in the application.
- Define the motor direction of rotation used to reach the stop selected above (forward (CW) rotation by default).
- To protect the application and prevent the mechanical stop being reached each time it returns to position zero, a position offset (in mm) can be set between the mechanical stop and position 1 corresponding to the application reference.

11.5.1.3. Application Settings

- To determine the maximum operating speed during the positioning phases, the user should enter the maximum linear speed in mm/s and the "Step of the screw" and "Mechanical ratio between the motor and the screw" adjustment parameters are used to obtain a motor speed of rotation according to the formula below:

11.5.2. "Clamp" Application Program

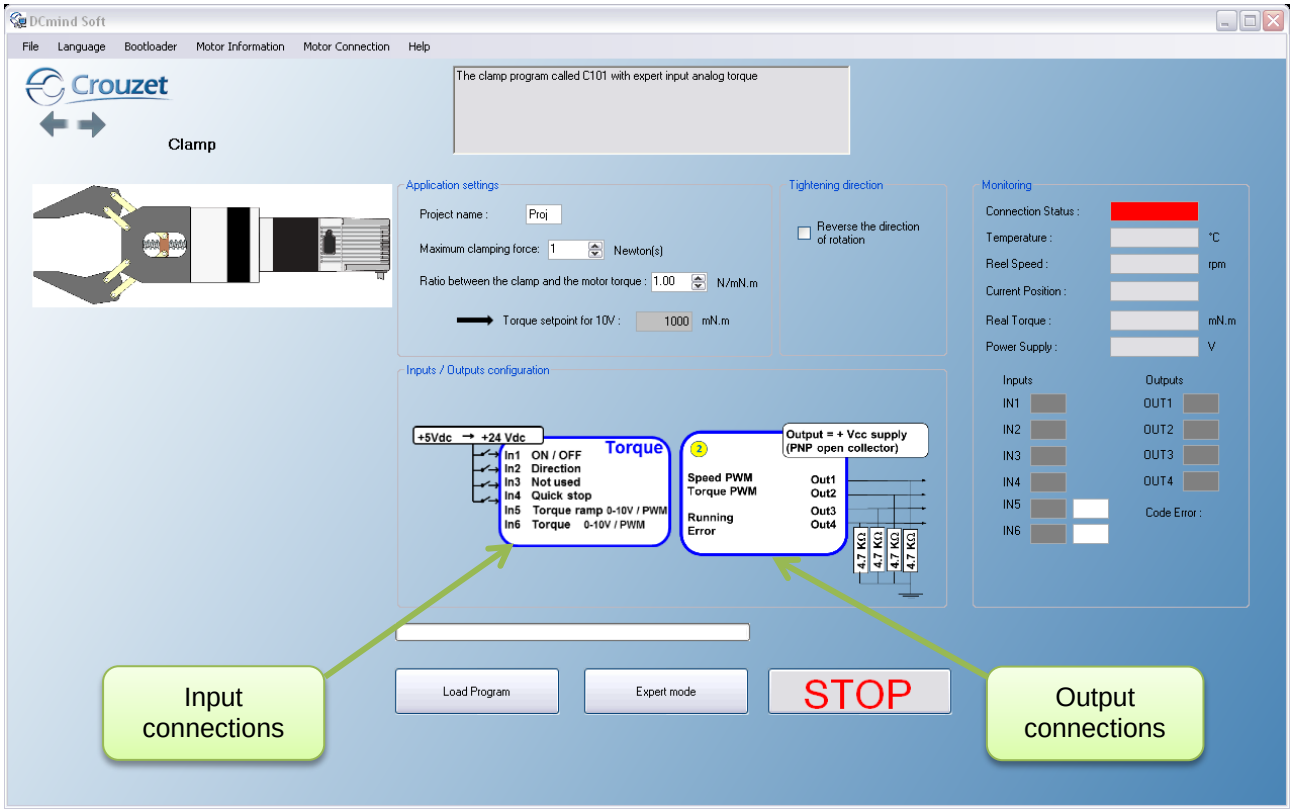


Figure 46

The "Clamp" application program invokes the C101 expert program.
The user can switch to this expert mode at any time to access all the settings by clicking the "Expert Mode" button.
The values preset in application mode will be loaded directly in expert mode.
It is then impossible to return to this application program.

The user can press the "STOP" button at any time to stop the application quickly.
To restart the motor, the program needs to be reloaded.

Once the settings are complete, press the "Load Program" button to configure the motor.

11.5.2.1. Inputs/Outputs Configuration

Refer to the "I/O Connection" section.

Inputs:

- IN1: If 0 → Stop, if 1 → Run
- IN2: If 0 → motor running in reverse (CCW), if 1 → motor running forward (CW)
- IN3: Not used.
- IN4: If 0 → no action, if 1 → Quick start by short-circuiting the coils. This action takes priority over the other commands.
- IN5: 0-10 V control. Sets the motor torque ramp. 20,000 mNm/sec for 0 V (maximum ramp) and 100 mNm/sec for 10 V.
- IN6: 0-10 V control. Sets the torque setpoint. 0V for 0 mNm and 10V for the maximum motor torque defined by the user (value in the grayed-out box).

Outputs: Don't forget to fit the pull-down resistors on each of the outputs.

- OUT1: Provides information on the motor speed value in PWM.
  Cyclical ratio = 0% → speed = 0 rpm
  Cyclical ratio = 100% → speed = 4000 rpm.
- OUT2: Provides information on the real torque value in PWM.
  Cyclical ratio = 0% → torque = 0 mNm
  Cyclical ratio = 100% → torque = maximum torque.
- OUT3: If 0 → motor running, if 1 → motor stopped.
- OUT4: If 0 → error detected, if 1 → no error.

11.5.2.2. Application Settings

- The user can give a 4-character name in "Project name" which is stored in the motor and appears in the "Motor Information" window.
- If it has been saved on the PC by the user, this name is used by default. For more details, see the "Saving Parameters" paragraph.
- The maximum motor torque corresponding to a voltage of 10 V is calculated as follows:

12. EXPERT PROGRAMS

12.1. Speed Programs

12.1.1. Types of Inputs in V100 Programs

The table below defines the function associated with each of the inputs in the 4 V100 programs (the color associated with the input number corresponds to that of the I/O bundle):

	Programs			
Inputs	**V101**	**V102**	**V103**	**V104**
In1	ON/OFF	ON/OFF	000 : "In6" setpoint speed 001 : Priority speed 1 010 : Priority speed 2 100 : Priority speed 3	8 combinations: Coding 8 preprogrammed speeds
In2	Direction	Direction		
In3	Holding	Holding		
In4	Fast stop	Fast stop	00 : Fast stop 10 : CCW 01 : CW 11 : Stop, disable error	00 : Fast stop 10 : CCW 01 : CW 11 : Stop, disable error
In5	Speed ramp	Nominal torque		
In6	Speed	Speed	Speed (if In1 = In2 = In3 = 0)	Nominal torque

Key: Digital type input

Analog or PWM type input

12.1.2. Types of Outputs in V100 Programs

For all expert speed programs, 4 configurable output configurations are available (the color associated with the output number corresponds to that of the I/O bundle):

	Out1	**Out2**	**Out3**	**Out4**
Type 1	Hall pulse *pulse*	Real torque *PWM*	Direction of rotation *Digital*	Error *Digital*
Type 2	Real speed *PWM*	Real torque *PWM*	Motor running *Digital*	Error *Digital*
Type 3	Real speed *Frequency*	Direction of rotation *Digital*	Motor running *Digital*	Error *Digital*
Type 4	Real speed (centered on 50%) *PWM*	Real torque (centered on 50%) *PWM*	00 : error detected 01 : motor running 10 : motor stopped in holding mode 11 : motor stopped and freewheeling *Digital combinations*	

Key: Digital type output

PWM/Pulse/Frequency type output

12.1.3. Description of the Various Tabs

For the description of tabs, expert program V101 is used as an example (for detailed information about each speed expert program, see the "Expert Program V101" to "Expert Program V104" sections in this document).

12.1.3.1. Home Page

This page is common to all the expert and application programs, whether in speed, position or torque mode. It can be used to choose between the various types of application and expert programs.

In our example, we have chosen the "Speed V100" category in the "Expert Programs" group, so the icons for the various V100 expert programs appear in the bottom right-hand corner of the window, and you then need to click on the one corresponding to the "V101" expert program:

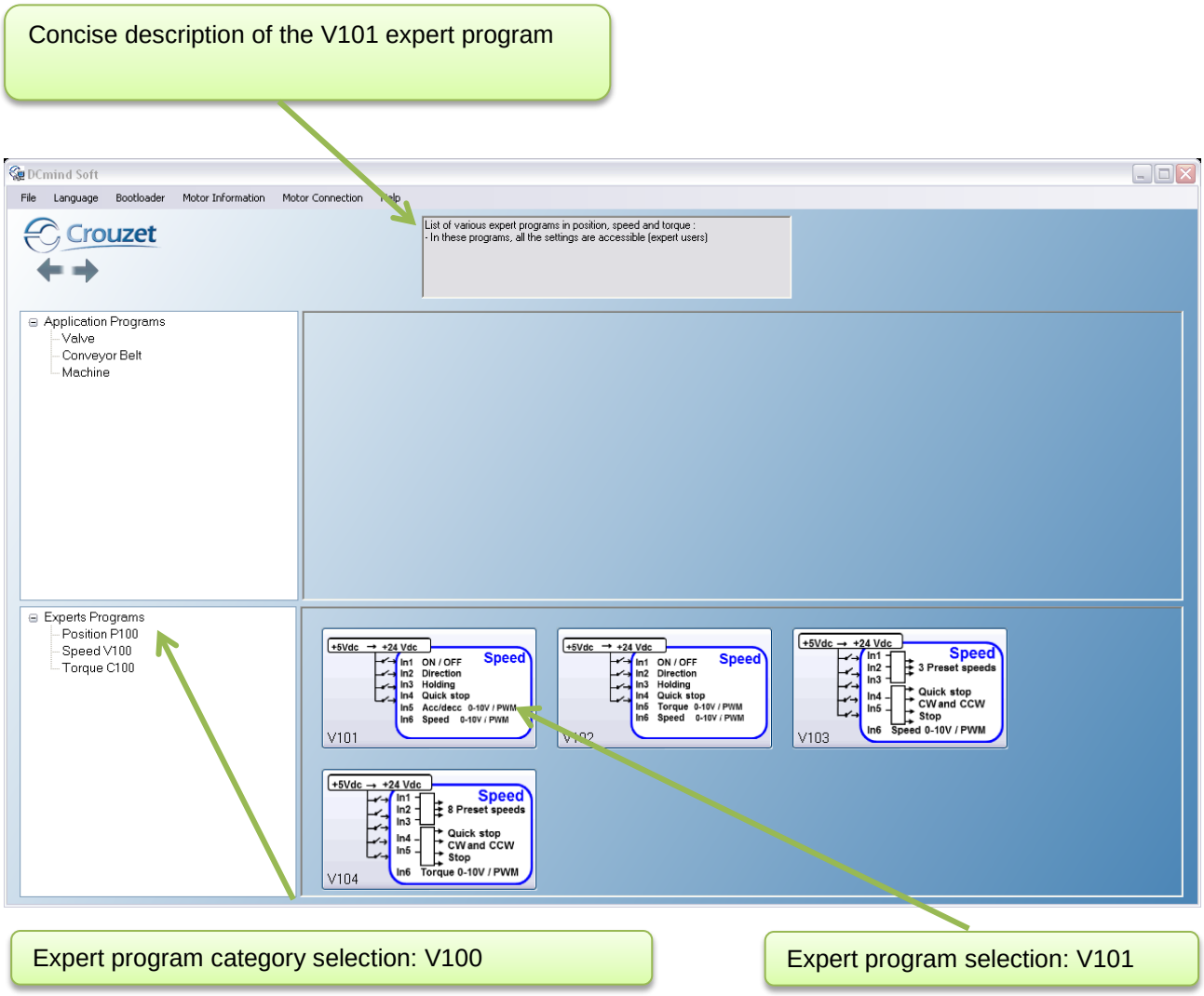


Figure 47

12.1.3.2. "Description" Tab

This is an information tab containing a concise description of the various speed profiles that are created using this expert mode:

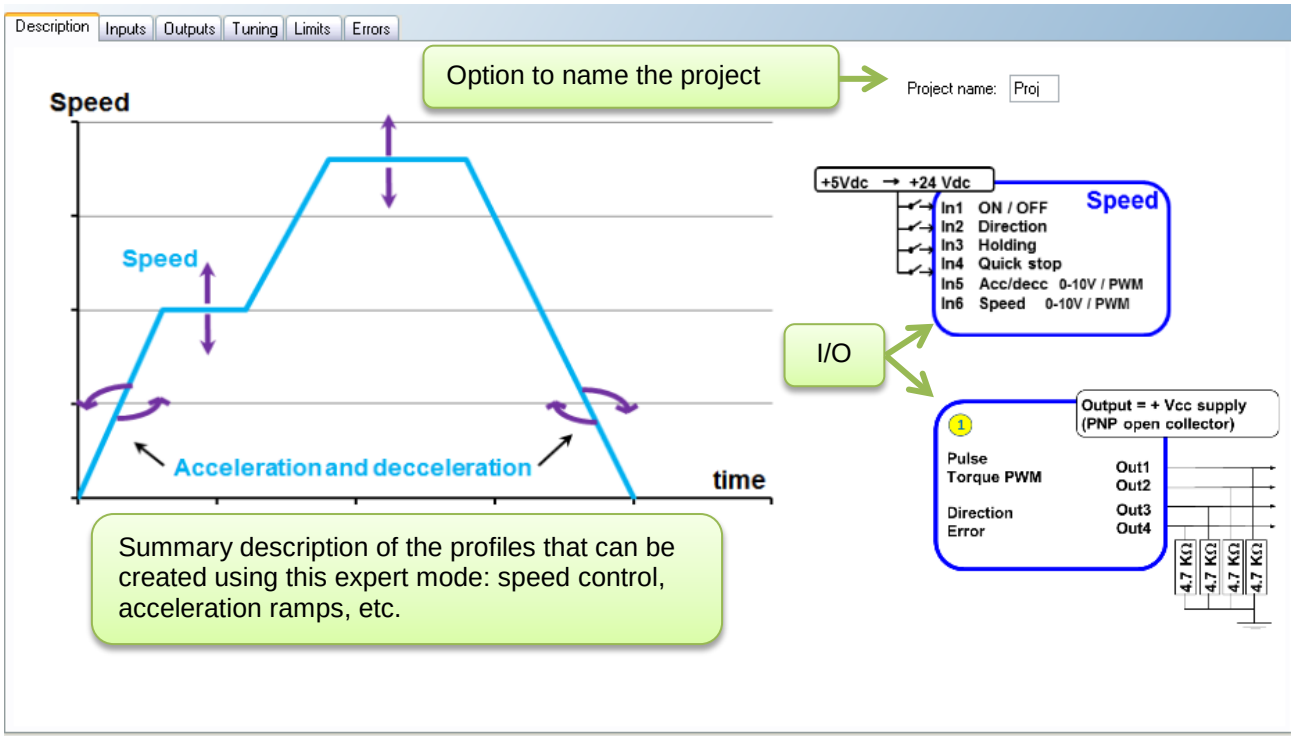


Figure 48

12.1.3.3. "Inputs" Tab

This tab is used to configure the various inputs in this expert mode (digital input polarity, value, control type, maximum and minimum control limit, etc.):

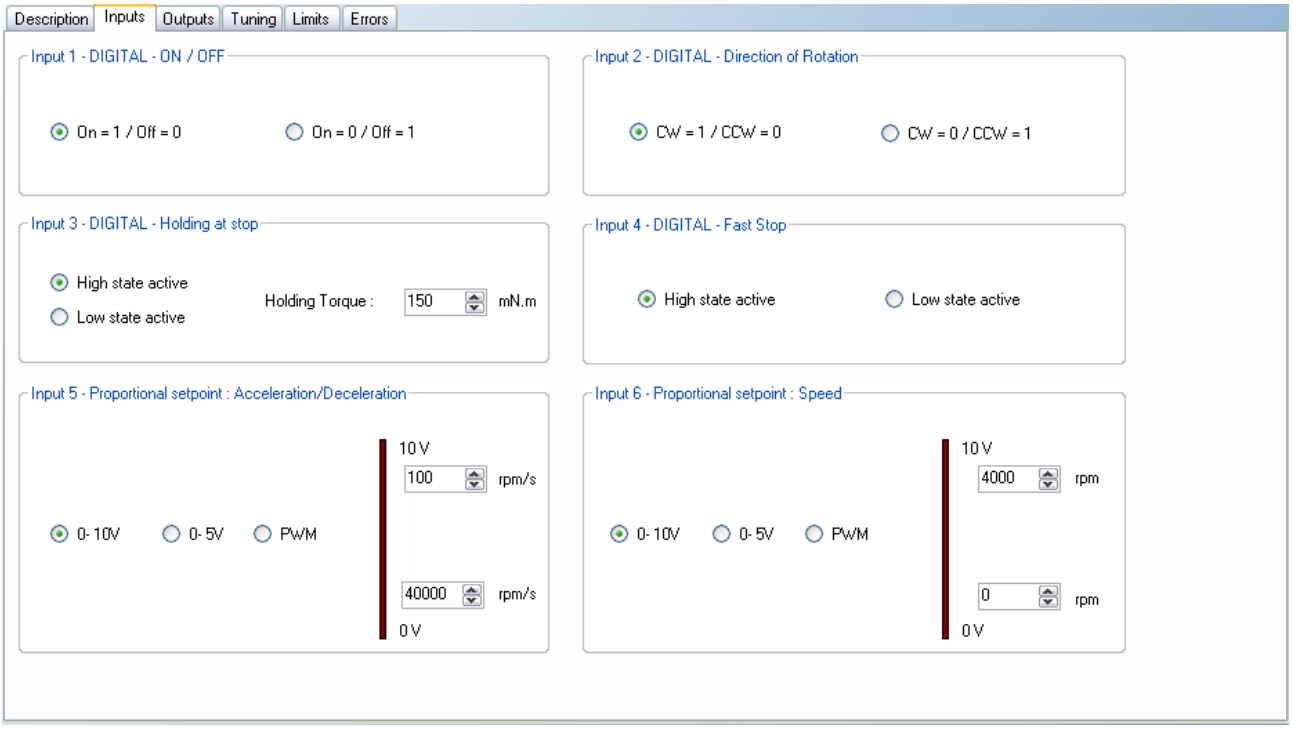


Figure 49

12.1.3.4. "Outputs" Tab

This tab is used to select and configure the various outputs in this expert mode (speed type 1 to type 4):

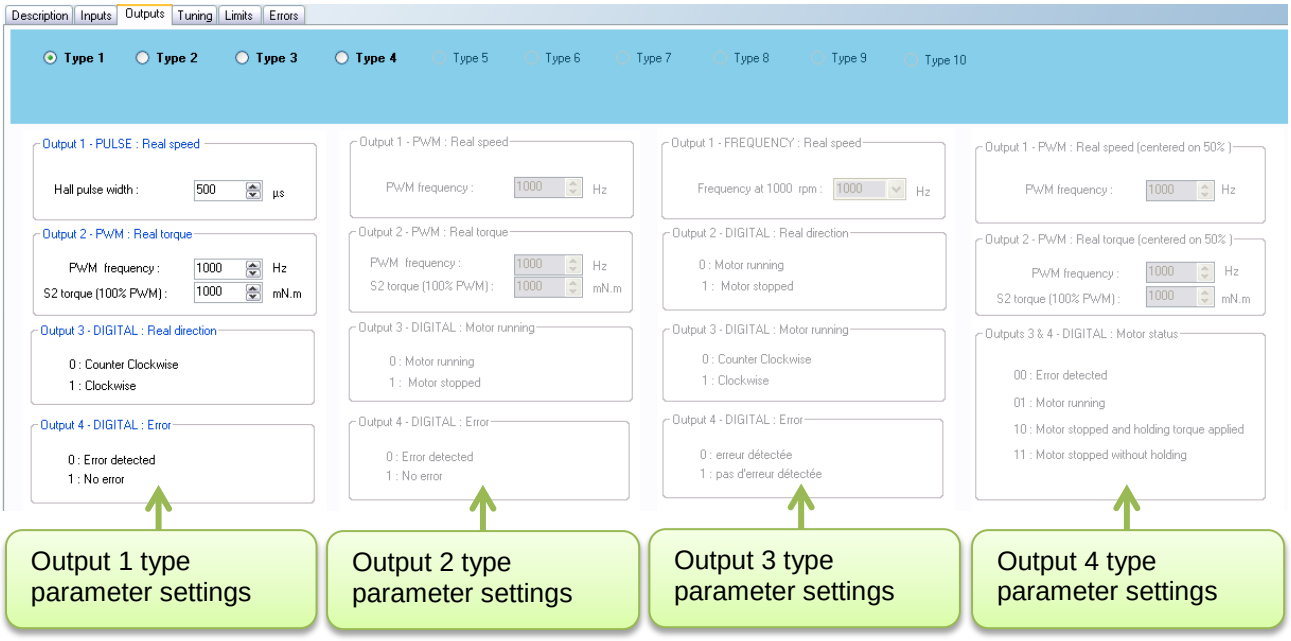


Figure 50

12.1.3.5. "Tuning" Tab

This tab is used to represent some parameters (speed, torque, etc.) in graphic form and modify the speed control loop coefficients. It is common to all the speed expert programs.

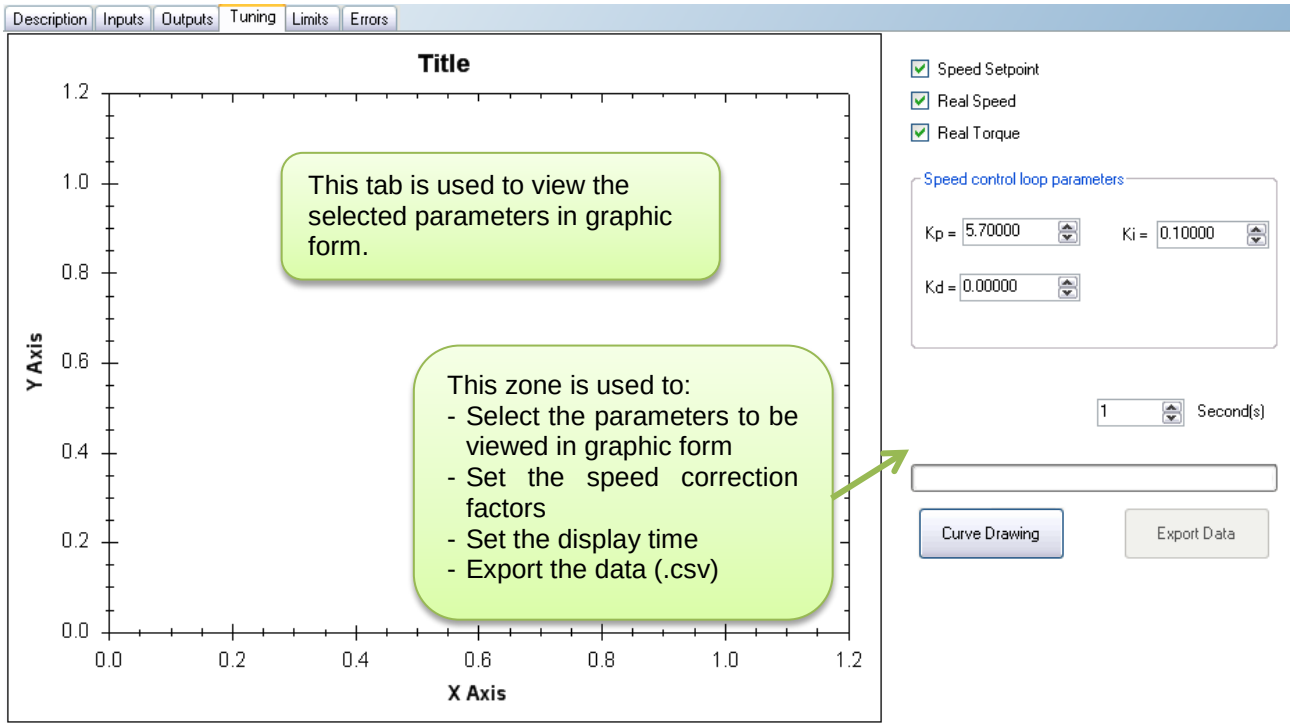
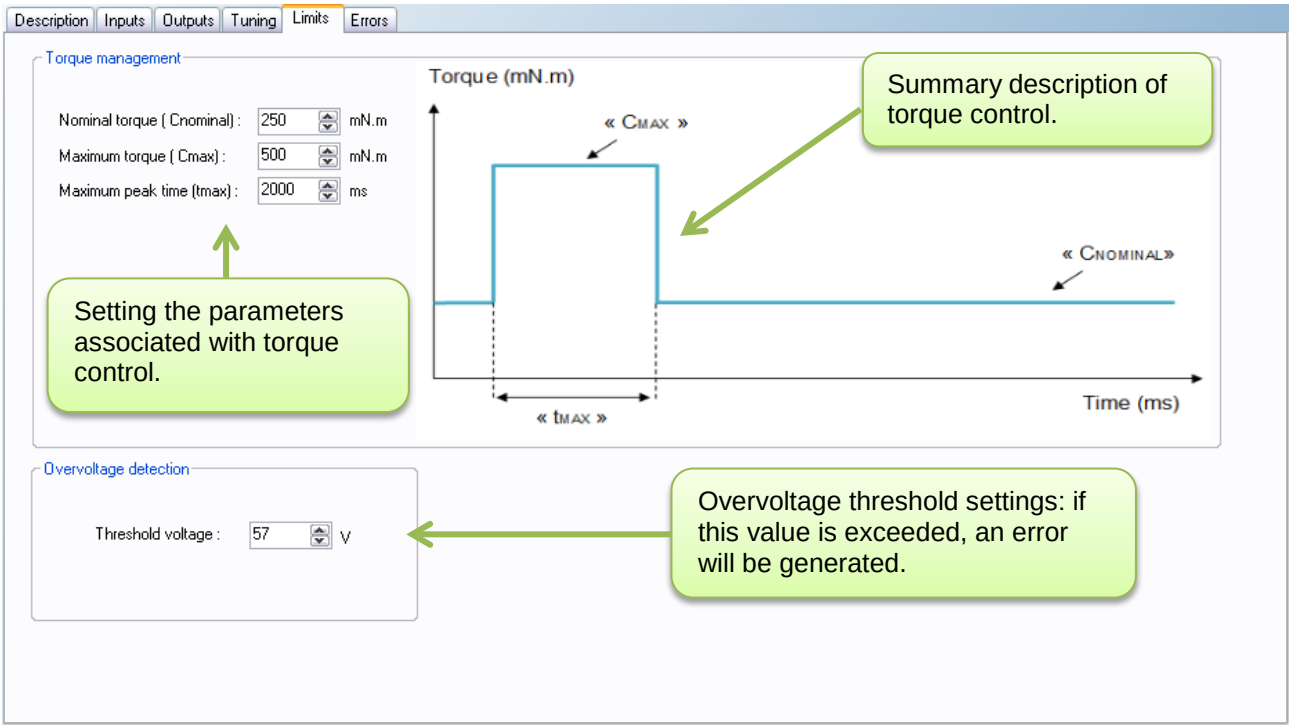


Figure 51

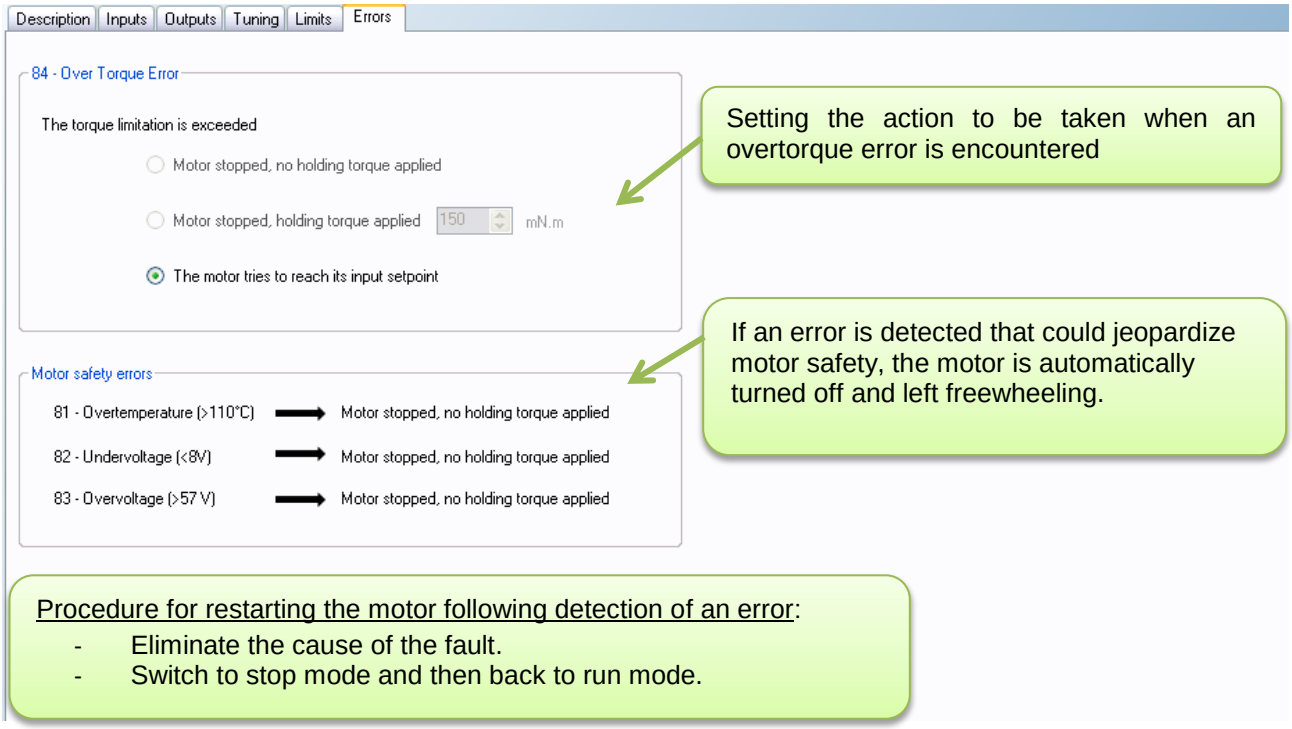
12.1.3.6. "Limits" Tab

This tab is used to configure the various motor operating limits: nominal and maximum torque (torque peak authorization) and the power supply overvoltage threshold.



12.1.3.7. "Errors" Tab

This tab provides information about the type of error encountered (based on the error code) and the action to be taken by the motor following this error. Action for the overtorque error can be configured.


Description
Inputs
Outputs
Tuning
Limits
Errors
84 - Over Torque Error
The torque limitation is exceeded
Motor stopped, no holding torque applied
Motor stopped, holding torque applied
150
mN.m
The motor tries to reach its input setpoint
Setting the action to be taken when an overtorque error is encountered
Motor safety errors
81 - Overtemperature (>110°C)
Motor stopped, no holding torque applied
82 - Undervoltage (<8V)
Motor stopped, no holding torque applied
83 - Overvoltage (>57 V)
Motor stopped, no holding torque applied
If an error is detected that could jeopardize motor safety, the motor is automatically turned off and left freewheeling.
Procedure for restarting the motor following detection of an error:
- Eliminate the cause of the fault.
- Switch to stop mode and then back to run mode.

12.1.4. Expert Program V101

12.1.4.1. Description

Expert program V101 is used to:

- Create speed profiles with analog or PWM control.
- Set the acceleration/deceleration phases with analog or PWM control.
- Set the nominal and maximum torque parameters for the application safety via the HMI.

12.1.4.2. "*Inputs*" Tab Parameters

Digital input 1: Used to set the "On/Off" input polarity.

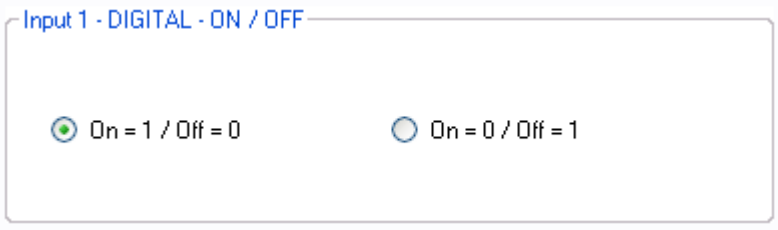


Figure 52

Digital input 2: Used to set the "Direction of rotation" input polarity.

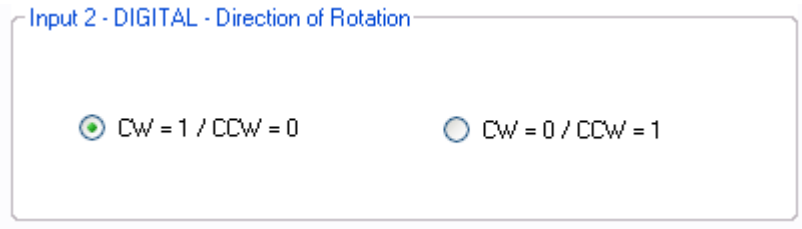


Figure 53

Digital input 3: Used to set the "Holding at stop" input polarity and set the Holding Torque value.

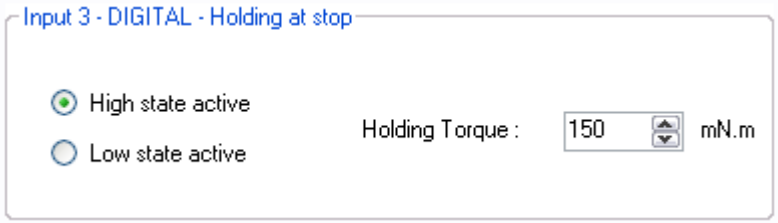


Figure 54

Digital input 4: Used to set the "Fast stop" input polarity.

This input is used to stop the motor as quickly as possible, ignoring the setpoints applied to the other inputs.

Figure 55

Setpoint input 5: Used to select the control type for the acceleration/deceleration setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

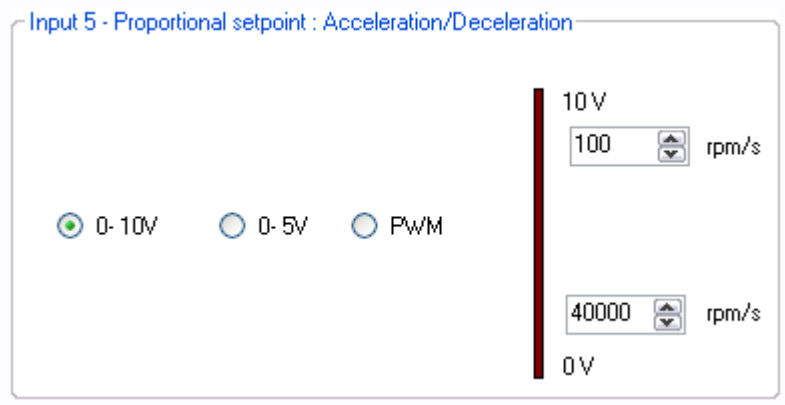


Figure 56

Setpoint input 6: Used to select the control type for the speed setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

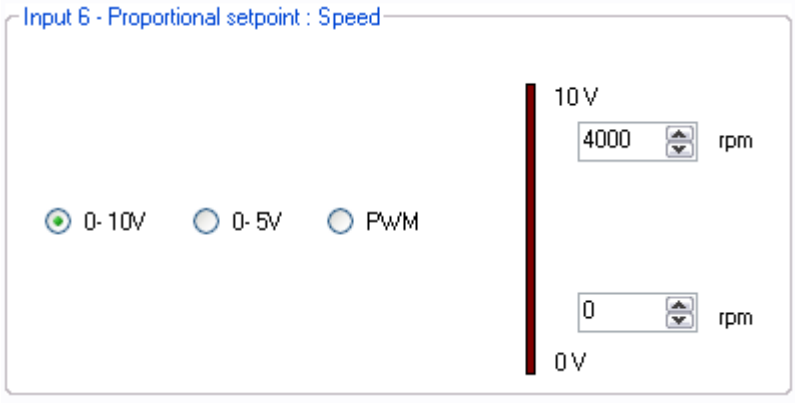


Figure 57

12.1.4.3. Type 1 "*Outputs*" Tab Parameters

Setting the parameters of Pulse output 1 "Real speed": A Hall pulse with configurable width (100 to 800 µs) is generated each time one of the 3 motor Hall sensors changes state.

80140_SMI21 and 80180_SMI21 motors have 12 Hall pulses per revolution (2 pairs of poles).
The 80280_SMI21 motor has 24 Hall pulses per revolution (4 pairs of poles).

Figure 58

Setting the parameters of PWM output 2 "Real Torque": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Torque supplied = "S2 torque".

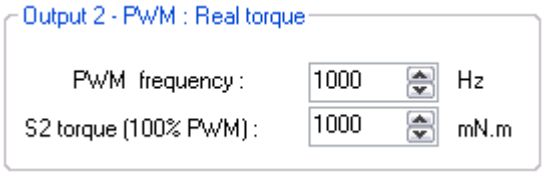


Figure 59

State of digital output 3 "Real direction": Used to find out the motor direction of rotation.

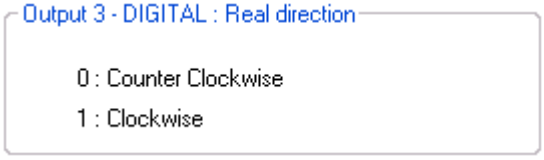


Figure 60

State of digital output 4 "Error": Used to find out whether an error has been detected.

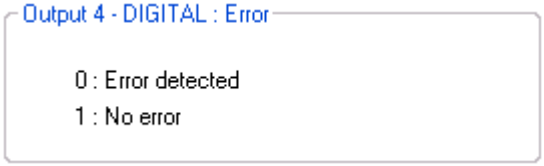


Figure 61

12.1.4.4. Type 2 "*Outputs*" Tab Parameters

Setting the parameters of PWM output 1 "Real Speed": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Real speed = 0 rpm.
If cyclical ratio = 100% → Real speed = maximum speed setpoint defined in In6.

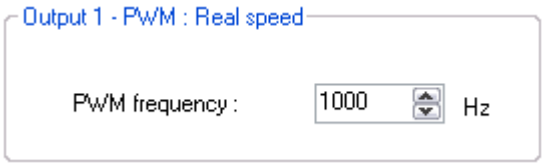


Figure 62

Setting the parameters of PWM output 2 "Real Torque": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Torque supplied = "S2 torque".

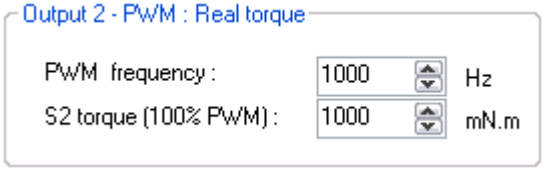


Figure 63

State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

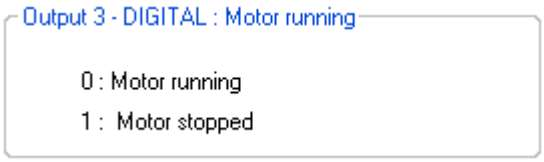


Figure 64

State of digital output 4 "Error": Used to find out whether an error has been detected.

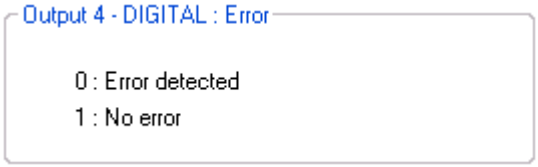


Figure 65

12.1.4.5. Type 3 "*Outputs*" Tab Parameters

Setting the parameters of frequency output 1 "Real speed": The parameters can be set for the signal frequency of this output for which the motor runs at 1000 RPM (200, 500 or 1000 Hz).

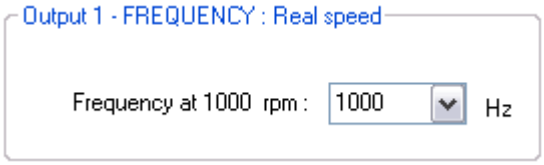


Figure 66

State of digital output 2 "Real direction": Used to find out the motor direction of rotation.

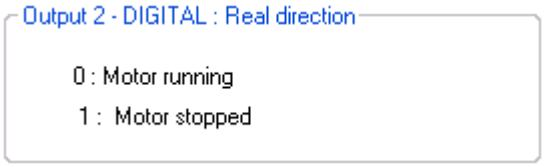


Figure 67

State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

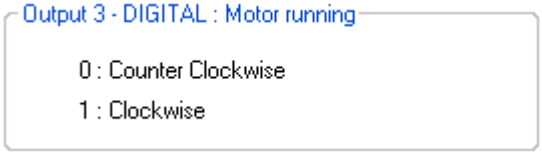


Figure 68

State of digital output 4 "Error": Used to find out whether an error has been detected.

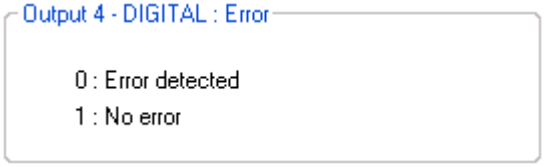


Figure 69

12.1.4.6. Type 4 "*Outputs*" Tab Parameters

Setting the parameters of PWM output 1: "Real speed (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Motor running forward (CW) at maximum speed setpoint defined in In6.
If cyclical ratio = 50% → Real speed = 0 rpm.
If cyclical ratio = 100% → Motor running in reverse (CCW) at maximum speed setpoint defined in In6.

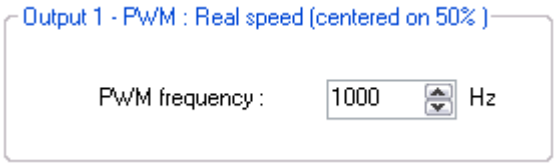


Figure 70

Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".
If cyclical ratio = 50% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

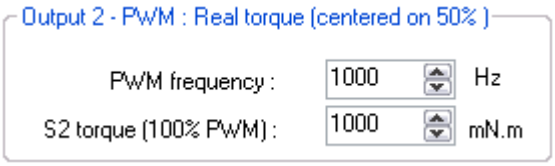


Figure 71

Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

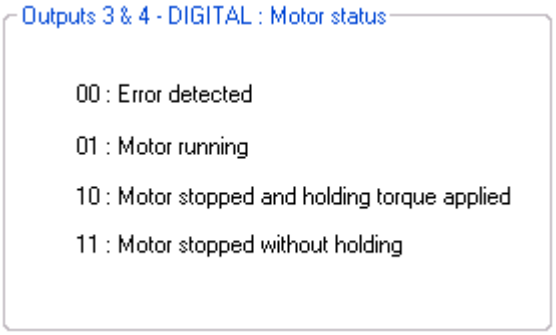

Outputs 3 & 4 - DIGITAL : Motor status
00 : Error detected
01 : Motor running
10 : Motor stopped and holding torque applied
11 : Motor stopped without holding

Figure 72

12.1.4.7. "*Tuning*" Tab Parameters

Selection of the various parameters to be represented in graphic form: either 1, 2 or 3 parameters. The system speed response (measurement vs setpoint) can therefore be compared while displaying changes in the current.

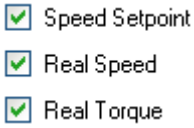


Figure 73

Set the PID controller factors in the speed control loop (this function is reserved for advanced users). The values given in the example below ensure correct product operation in the majority of cases.

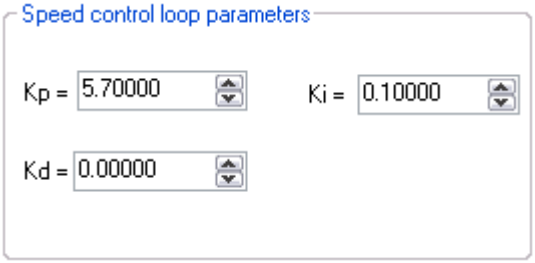


Figure 74

It is possible to set the recording time you wish to view, from 1 to 300 seconds.
The sampling interval is 10 ms.
During data acquisition, the other HMI functions are not available.

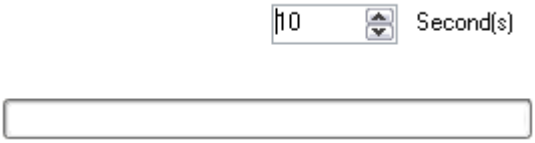


Figure 75

"Curve Drawing" button: used to start data acquisition. Curves are only displayed once acquisition is complete.

"Export Data" button: used to retrieve data corresponding to the selected parameters in a text file (*.txt*). To make this file compatible with the Excel spreadsheet, change its extension to .csv.

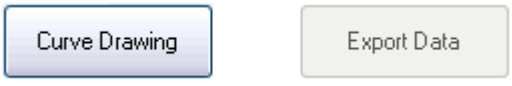


Figure 76

Example: With a speed setpoint on input 6 at 3200 RPM and an acceleration setpoint on input 5 at 800 RPM/s, this gives us the following graphic representation (recording time of 10 seconds):

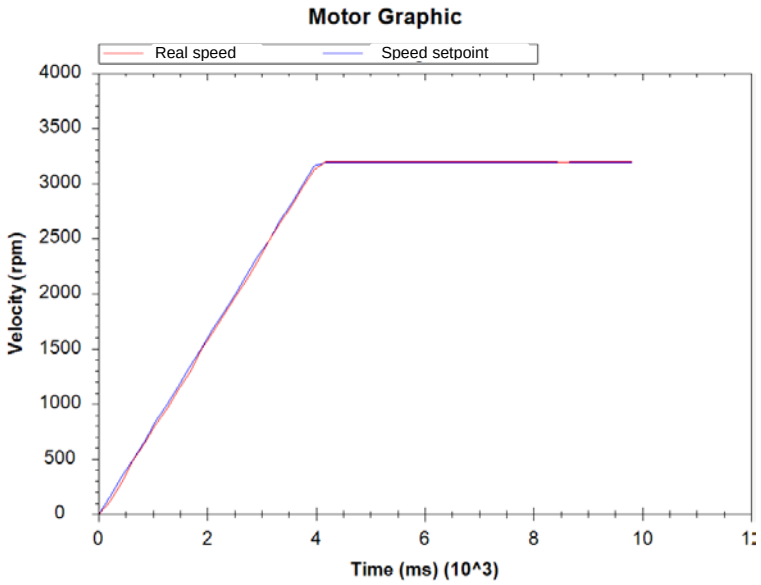


Figure 77

Note: The display scales can be changed with the mouse wheel. Other functions are available by right-clicking the mouse.

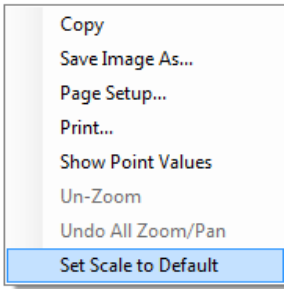


Figure 78

12.1.4.8. "*Limitations*" Tab Parameters

WARNING

UNEXPECTED MOVEMENT
An inappropriate setting for the torque values can result in unexpected movements of the application and destruction of the motor.
• Make sure this will not cause any damage.
• Do not continue with the test if there is anyone or any obstacle in the hazardous zone.
Failure to comply with these precautions will result in death, serious injury or equipment damage.

This tab can be used to set the limit values for various parameters.

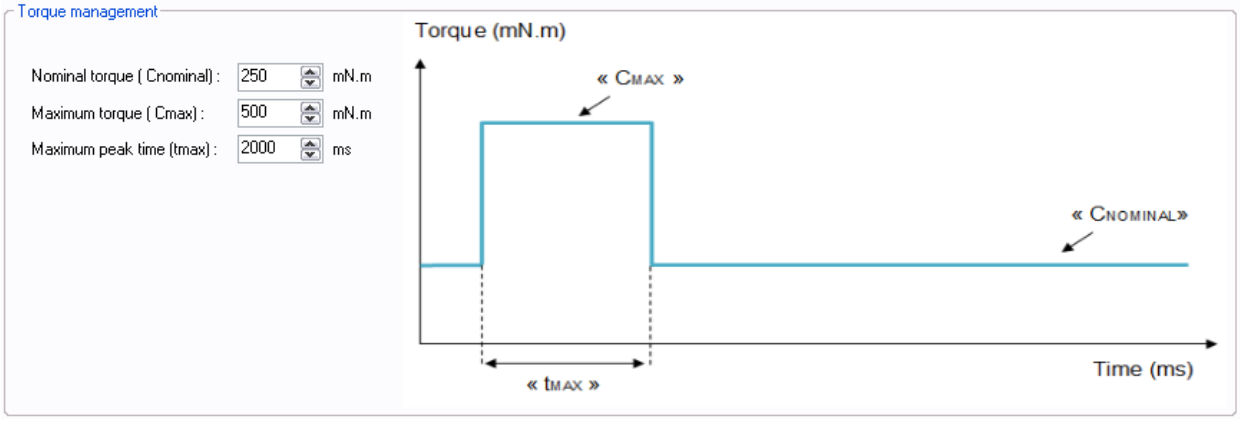


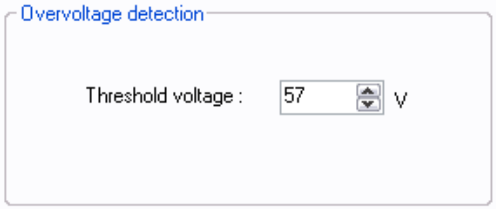
Figure 79

Setting the various torque parameters: When the application torque exceeds the torque "$C_{NOMINAL}$", the motor can provide torque up to the value "C_{MAX}" for the maximum duration "t_{MAX}". Thereafter, if the application torque is still higher than "$C_{NOMINAL}$", the motor torque is limited to the value "$C_{NOMINAL}$" until the application torque falls back below this value.

WARNING

VOLTAGE SURGES
During the braking phases, the motor generates voltage surges.
• Check that its voltage surges can be tolerated by the other devices connected to the same power supply.
• Use an external circuit to limit voltage surges if the brake is being used intensively.
Failure to comply with these precautions will result in death, serious injury or equipment damage.

Setting the overvoltage detection threshold parameters: If the voltage at the motor terminals exceeds this threshold, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).



12.1.4.9. "*Errors*" Tab Parameters

Setting the parameters for the action to be taken when an overtorque error is encountered: real torque higher than the nominal torque "$C_{NOMINAL}$" for a time longer than "t_{MAX}".

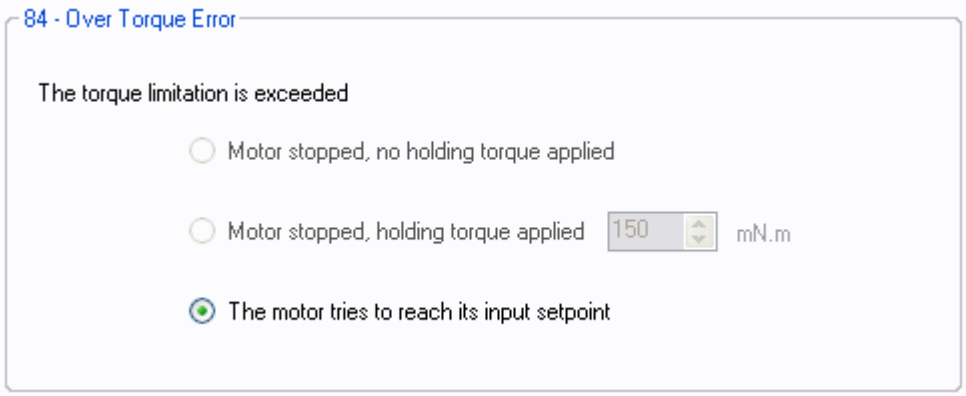


Figure 80

For all errors affecting motor safety, the action to be taken cannot be configured: in the event of an error, the motor is stopped and no holding torque is applied (freewheeling).

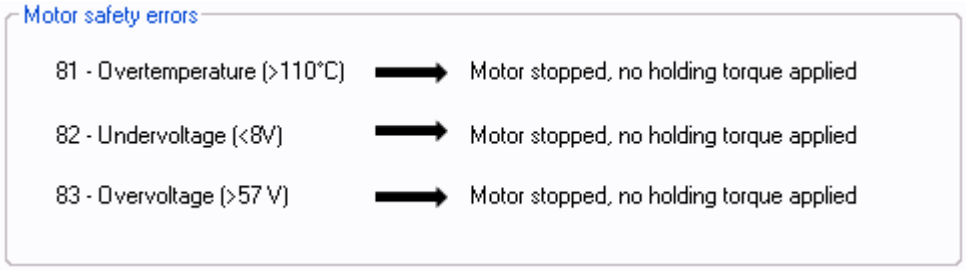


Figure 81

Procedure for restarting the motor following detection of an error:

- Eliminate the cause of the fault.
- Switch to stop mode: disable digital input 1 "On/Off".
- Switch back to run mode: enable digital input 1 "On/Off".

12.1.5. Expert Program V102

12.1.5.1. Description

Expert program V102 is used to:

- Create speed profiles with analog or PWM control.
- Set torque limiting with analog or PWM control.

12.1.5.2. "*Inputs*" Tab Parameters

Digital input 1: Used to set the "On/Off" input polarity.

Figure 82

Digital input 2: Used to set the "Direction of rotation" input polarity.

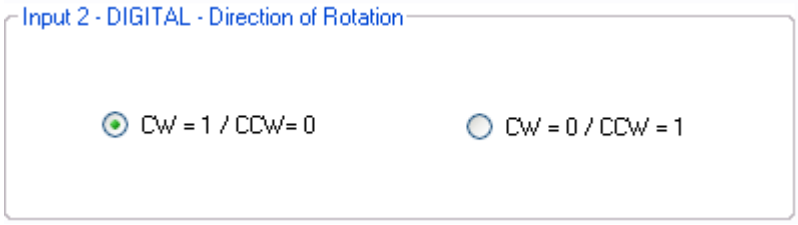


Figure 83

Digital input 3: Used to set the "Holding at stop" input polarity and set the Holding Torque value.

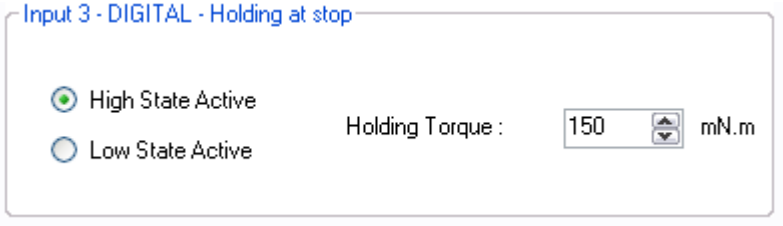


Figure 84

Digital input 4: Used to set the "Fast stop" input polarity.

This input is used to stop the motor as quickly as possible, ignoring the setpoints applied to the other inputs.

Figure 85

Setpoint input 5: Used to select the control type for the torque limiting setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

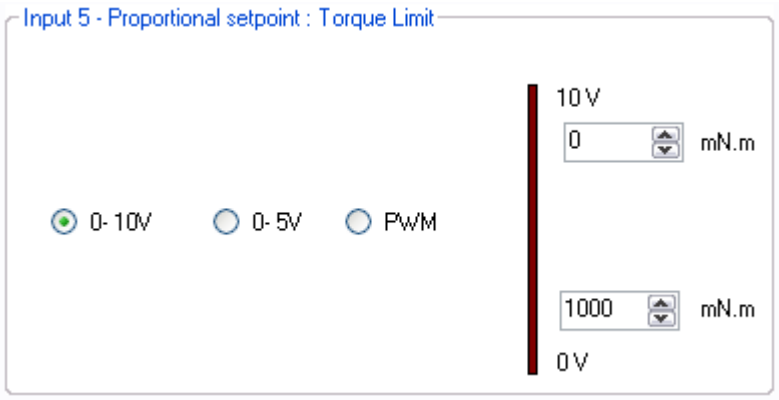


Figure 86

Setpoint input 6: Used to select the control type for the speed setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

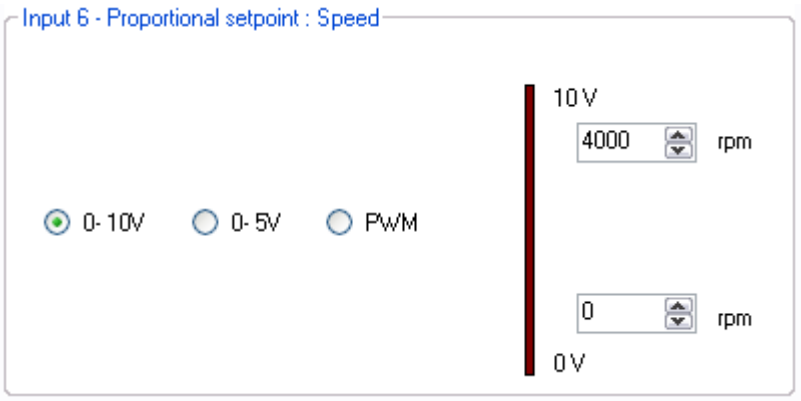


Figure 87

12.1.5.3. Type 1 "*Outputs*" Tab Parameters

Setting the parameters of Pulse output 1 "Real speed": A Hall pulse with configurable width (100 to 800 µs) is generated each time one of the 3 motor Hall sensors changes state.

80140_SMI21 and 80180_SMI21 motors have 12 Hall pulses per revolution (2 pairs of poles).
The 80280_SMI21 motor has 24 Hall pulses per revolution (4 pairs of poles).

Figure 88

Setting the parameters of PWM output 2 "Real Torque": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Torque supplied = "S2 torque".

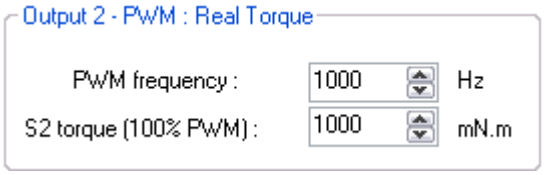


Figure 89

State of digital output 3 "Real direction": Used to find out the motor direction of rotation.

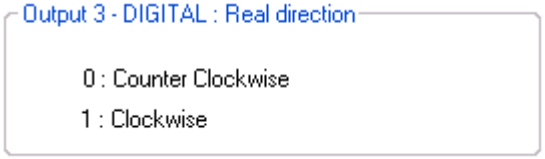


Figure 90

State of digital output 4 "Error": Used to find out whether an error has been detected.

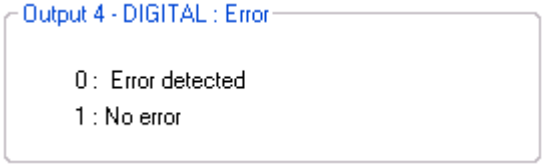


Figure 91

12.1.5.4. Type 2 "*Outputs*" Tab Parameters

Setting the parameters of PWM output 1 "Real Speed": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Real speed = 0 rpm.
If cyclical ratio = 100% → Real speed = maximum speed setpoint defined in In6.

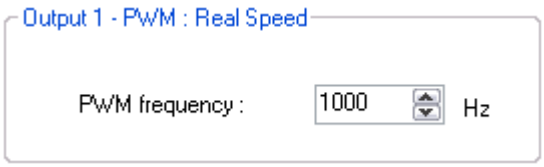


Figure 92

Setting the parameters of PWM output 2 "Real Torque": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Torque supplied = "S2 torque".

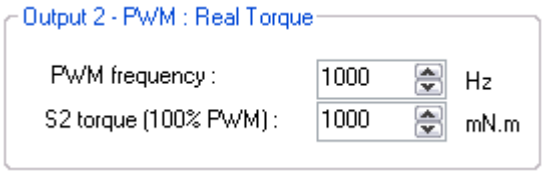


Figure 93

State of digital output 3 "Motor Running": Used to find out whether the motor is stopped or running.

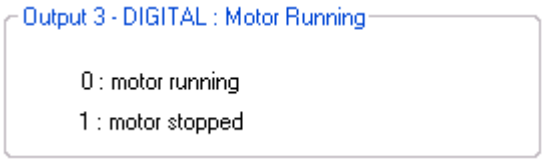


Figure 94

State of digital output 4 "Error": Used to find out whether an error has been detected.

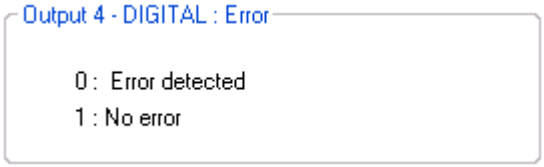


Figure 95

12.1.5.5. Type 3 "*Outputs*" Tab Parameters

Setting the parameters of frequency output 1 "Real speed": The parameters can be set for the signal frequency of this output for which the motor runs at 1000 RPM (200, 500 or 1000 Hz).

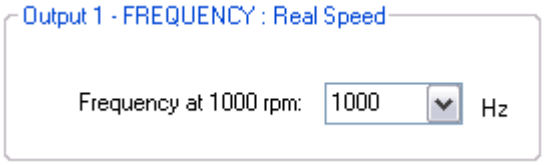


Figure 96

State of digital output 2 "Real direction": Used to find out the motor direction of rotation.

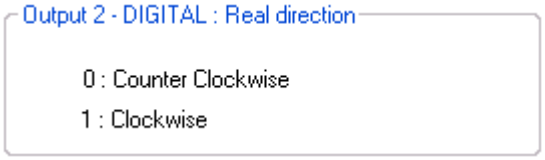


Figure 97

State of digital output 3 "Motor Running": Used to find out whether the motor is stopped or running.

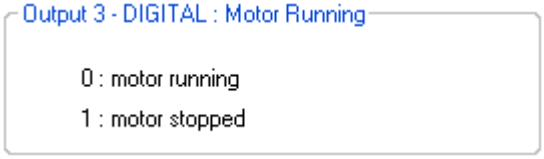


Figure 98

State of digital output 4 "Error": Used to find out whether an error has been detected.

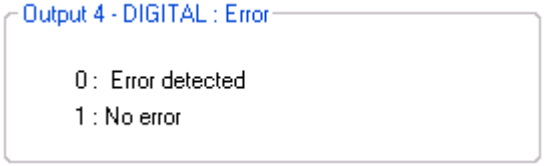


Figure 99

12.1.5.6. Type 4 "*Outputs*" Tab Parameters

Setting the parameters of PWM output 1: "Real speed (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Motor running forward (CW) at maximum speed setpoint defined in In6.
If cyclical ratio = 50% → Real speed = 0 rpm.
If cyclical ratio = 100% → Motor running in reverse (CCW) at maximum speed setpoint defined in In6.

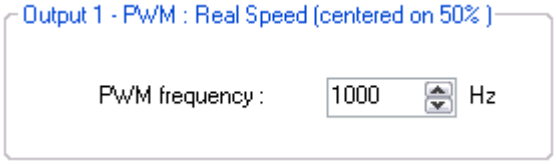


Figure 100

Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".
If cyclical ratio = 50% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

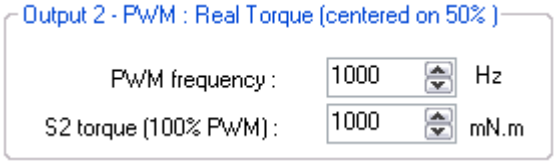


Figure 101

Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

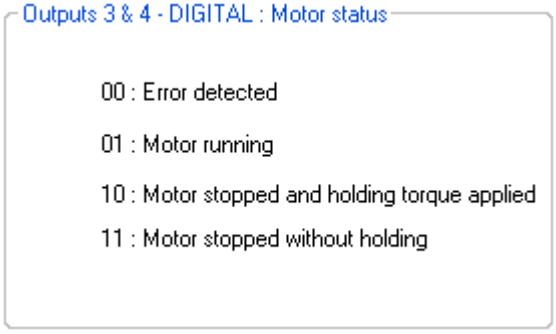

Outputs 3 & 4 - DIGITAL : Motor status
00 : Error detected
01 : Motor running
10 : Motor stopped and holding torque applied
11 : Motor stopped without holding

Figure 102

12.1.5.7. "*Tuning*" Tab Parameters

Selection of the various parameters to be represented in graphic form: either 1, 2 or 3 parameters. The system speed response (measurement vs setpoint) can therefore be compared while displaying changes in the current.

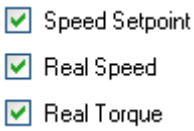


Figure 103

Set the PID controller factors in the speed control loop (this function is reserved for advanced users). The values given in the example below ensure correct product operation in the majority of cases.

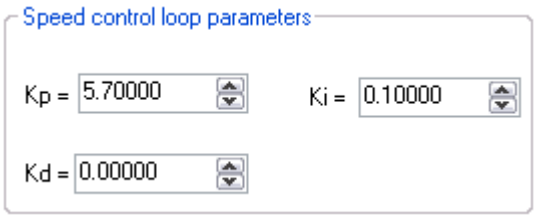


Figure 104

It is possible to set the recording time you wish to view, from 1 to 300 seconds.
The sampling interval is 10 ms.
During data acquisition, the other HMI functions are not available.

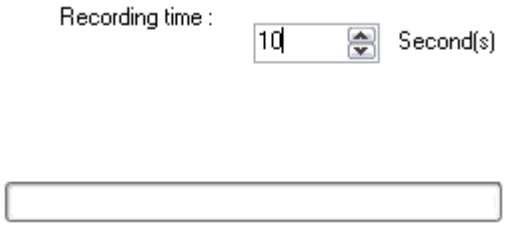


Figure 105

"Curve Drawing" button: used to start data acquisition. Curves are only displayed once acquisition is complete.

"Export Data" button: used to retrieve data corresponding to the selected parameters in a text file (*.txt*). To make this file compatible with the Excel spreadsheet, change its extension to .csv.

Figure 106

Example: With a speed setpoint on input 6 at 2000 RPM and a torque limit on input 5 at 1000 mN.m, this gives us the following graphic representation (recording time of 5 seconds):

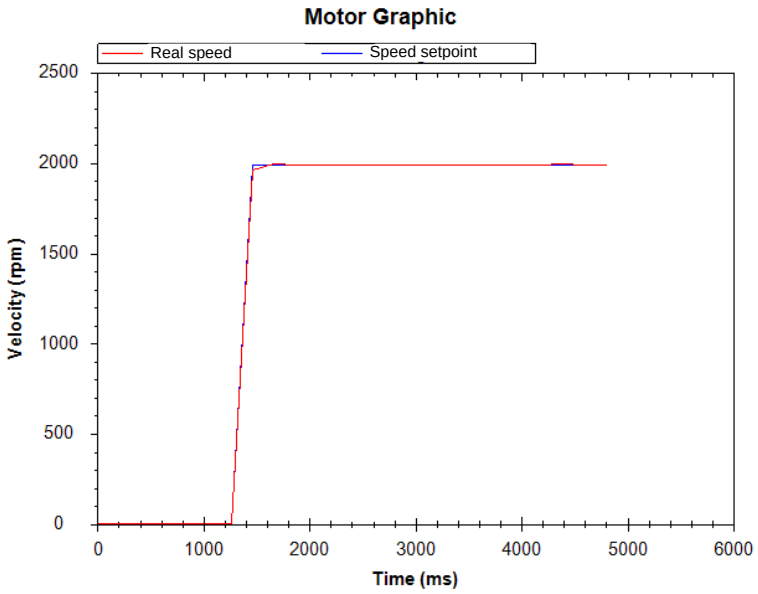


Figure 107

Note: The display scales can be changed with the mouse wheel. Other functions are available by right-clicking the mouse.

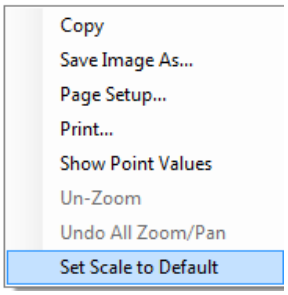


Figure 108

12.1.5.8. "*Limits*" Tab Parameters

WARNING
VOLTAGE SURGES During the braking phases, the motor generates voltage surges. • Check that its voltage surges can be tolerated by the other devices connected to the same power supply. • Use an external circuit to limit voltage surges if the brake is being used intensively. **Failure to comply with these precautions will result in death, serious injury or equipment damage.**

Setting the overvoltage detection threshold parameters: If the voltage at the motor terminals exceeds this threshold, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).

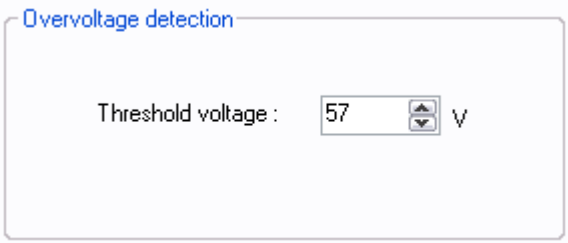


Figure 109

12.1.5.9. "*Errors*" Tab Parameters

For all errors affecting motor safety, the action to be taken cannot be configured: in the event of an error, the motor is stopped and no holding torque is applied (freewheeling).

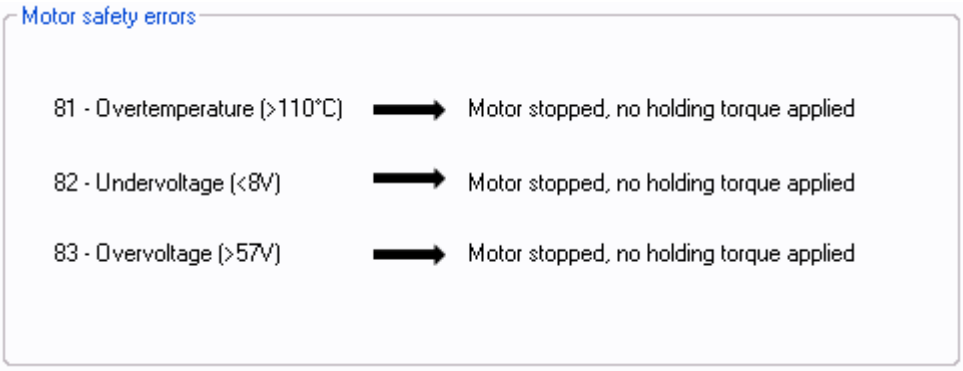


Figure 110

Procedure for restarting the motor following detection of an error:

- Eliminate the cause of the fault.
- Switch to stop mode: disable digital input 1 "On/Off".
- Switch back to run mode: enable digital input 1 "On/Off".

12.1.6. Expert Program V103

12.1.6.1. Description

Expert program V103 is used to:

- Create speed profiles with analog or PWM control.
- Force speed control to one of the 3 preprogrammed speeds.
- Set the acceleration/deceleration phase parameters via the HMI.

12.1.6.2. "*Inputs*" Tab Parameters

Combinations of digital inputs 1 to 3: Used to choose the type of speed setpoint applied at the motor input:

- If no input is active, the setpoint will be that applied to input 6.
- If one of these 3 inputs is active, the setpoint will be the priority speed associated with this input.

N.B.: If more than 1 input In1 to In3 is active, the setpoint taken into account will be that for input 6.

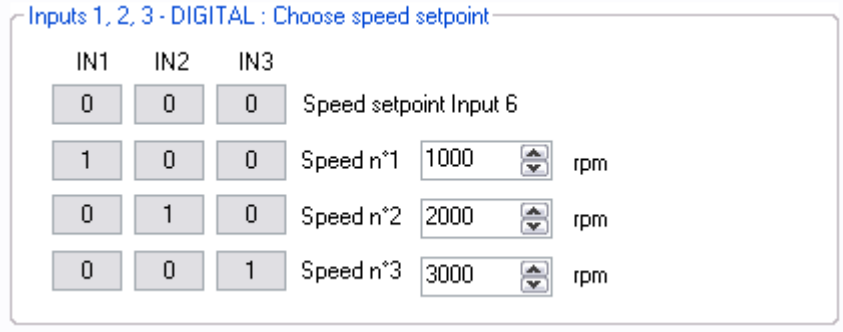

Inputs 1, 2, 3 - DIGITAL : Choose speed setpoint
IN1
IN2
IN3
0 0 0 Speed setpoint Input 6
1 0 0 Speed n°1 1000 rpm
0 1 0 Speed n°2 2000 rpm
0 0 1 Speed n°3 3000 rpm

Figure 111

Combinations of digital inputs 4 and 5: Used to choose the motion to be performed from the 4 actions indicated below.

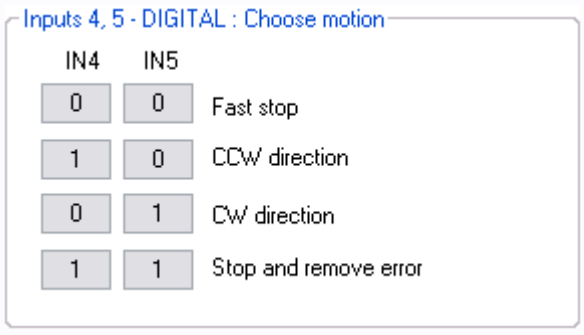


Figure 112

Setpoint input 6: Used to select the control type for the speed setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

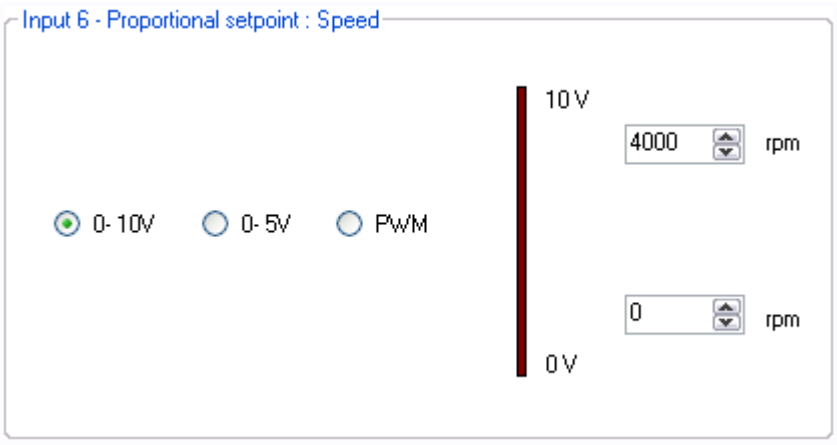


Figure 113

Setting the acceleration and braking ramps: These values are fixed via the HMI and cannot be changed by inputs while the motor is running. By default, the rates are fixed at 40,000 RPM/sec.

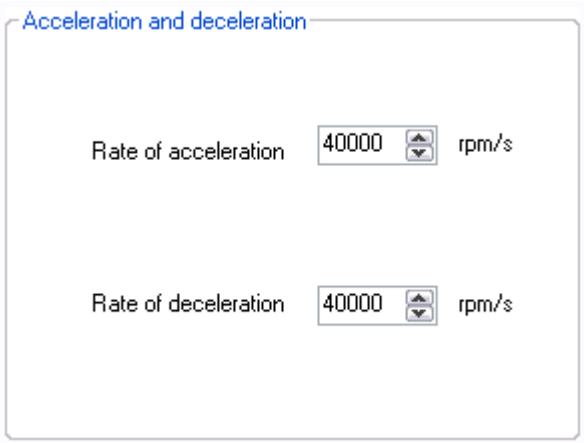


Figure 114

12.1.6.3. Type 1 "*Outputs*" Tab Parameters

Setting the parameters of Pulse output 1 "Real speed": A Hall pulse with configurable width (100 to 800 µs) is generated each time one of the 3 motor Hall sensors changes state.

80140_SMI21 and 80180_SMI21 motors have 12 Hall pulses per revolution (2 pairs of poles).
The 80280_SMI21 motor has 24 Hall pulses per revolution (4 pairs of poles).

Figure 115

Setting the parameters of PWM output 2 "Real torque": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Torque supplied = "S2 torque".

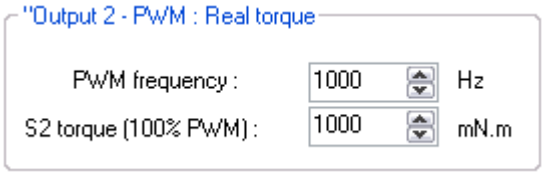


Figure 116

State of digital output 3 "Real direction": Used to find out the motor direction of rotation.

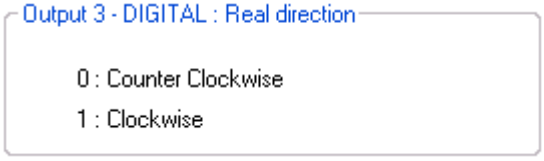


Figure 117

State of digital output 4 "Error": Used to find out whether an error has been detected.

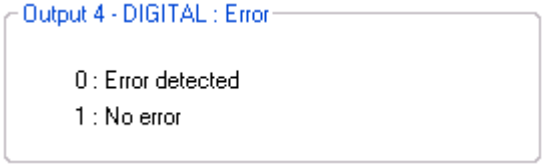


Figure 118

12.1.6.4. Type 2 "*Outputs*" Tab Parameters

Setting the parameters of PWM output 1 "Real speed": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Real speed = 0 rpm.
If cyclical ratio = 100% → Real speed = maximum speed setpoint defined in In6.

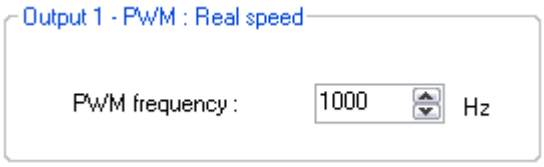


Figure 119

Setting the parameters of PWM output 2 "Real torque": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Torque supplied = "S2 torque".

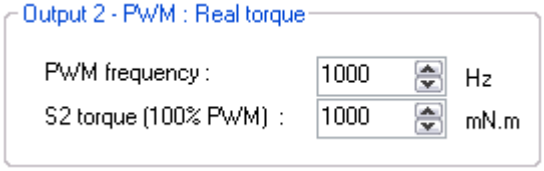


Figure 120

State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

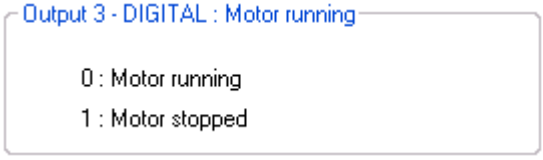


Figure 121

State of digital output 4 "Error": Used to find out whether an error has been detected.

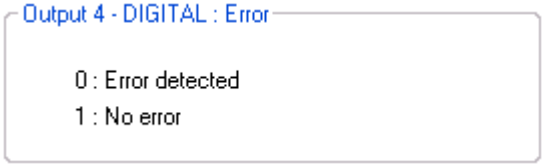


Figure 122

12.1.6.5. Type 3 "*Outputs*" Tab Parameters

Setting the parameters of frequency output 1 "Real speed": The parameters can be set for the signal frequency of this output for which the motor runs at 1000 RPM (200, 500 or 1000 Hz).

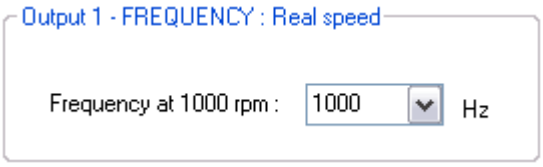


Figure 123

State of digital output 2 "Real direction": Used to find out the motor direction of rotation.

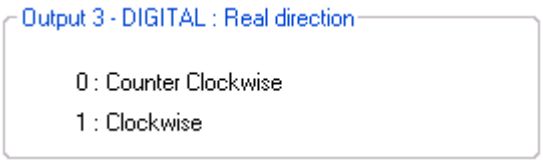


Figure 124

State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

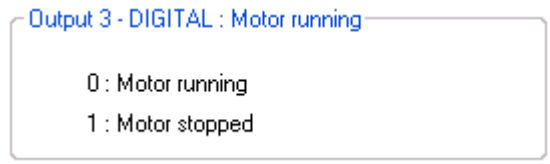


Figure 125

State of digital output 4 "Error": Used to find out whether an error has been detected.

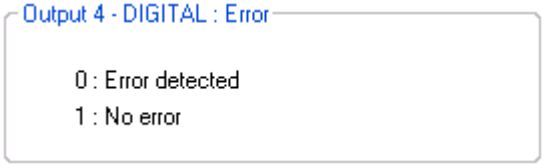


Figure 126

12.1.6.6. Type 4 "*Outputs*" Tab Parameters

Setting the parameters of PWM output 1: "Real speed (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Motor running forward (CW) at maximum speed setpoint defined in In6.
If cyclical ratio = 50% → Real speed = 0 rpm.
If cyclical ratio = 100% → Motor running in reverse (CCW) at maximum speed setpoint defined in In6.

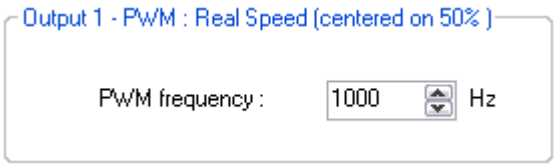


Figure 127

Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".
If cyclical ratio = 50% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

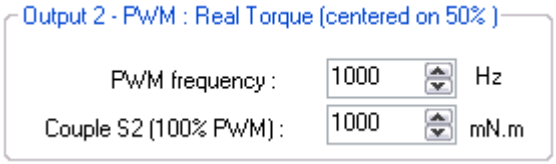


Figure 128

Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

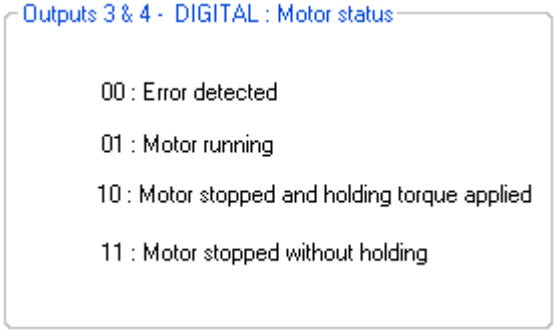

Outputs 3 & 4 - DIGITAL : Motor status
00 : Error detected
01 : Motor running
10 : Motor stopped and holding torque applied
11 : Motor stopped without holding

Figure 129

12.1.6.7. "*Tuning*" Tab Parameters

Selection of the various parameters to be represented in graphic form: either 1, 2 or 3 parameters. The system speed response (measurement vs setpoint) can therefore be compared while displaying changes in the current.

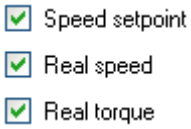


Figure 130

Set the PID controller factors in the speed control loop (this function is reserved for advanced users). The values given in the example below ensure correct product operation in the majority of cases.

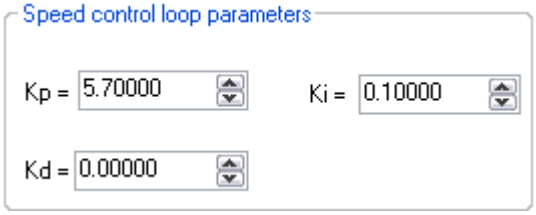


Figure 131

It is possible to set the recording time you wish to view, from 1 to 300 seconds.
The sampling interval is 10 ms.
During data acquisition, the other HMI functions are not available.

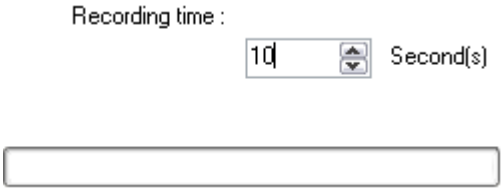


Figure 132

"Curve Drawing" button: used to start data acquisition. Curves are only displayed once acquisition is complete.

"Export Data" button: used to retrieve data corresponding to the selected parameters in a text file (*.txt*). To make this file compatible with the Excel spreadsheet, change its extension to .csv.

Figure 133

Example: With a priority speed on input 1 at 1000 RPM, a priority speed on input 2 at 2000 RPM and a priority speed on input 3 at 3000 RPM, this gives us the following graphic representation (recording time of 10 seconds):

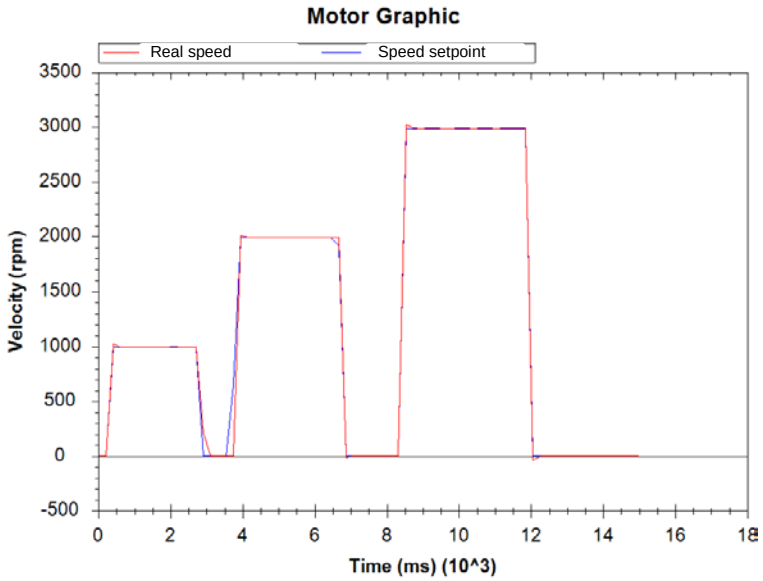


Figure 134

Note: The display scales can be changed with the mouse wheel. Other functions are available by right-clicking the mouse.

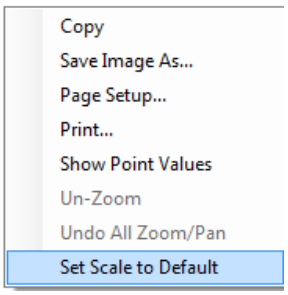


Figure 135

12.1.6.8. "*Limits*" Tab Parameters

WARNING

UNEXPECTED MOVEMENT
An inappropriate setting for the torque values can result in unexpected movements of the application and destruction of the motor.
• Make sure this will not cause any damage.
• Do not continue with the test if there is anyone or any obstacle in the hazardous zone.
Failure to comply with these precautions will result in death, serious injury or equipment damage.

This tab can be used to set the limit values for various parameters.

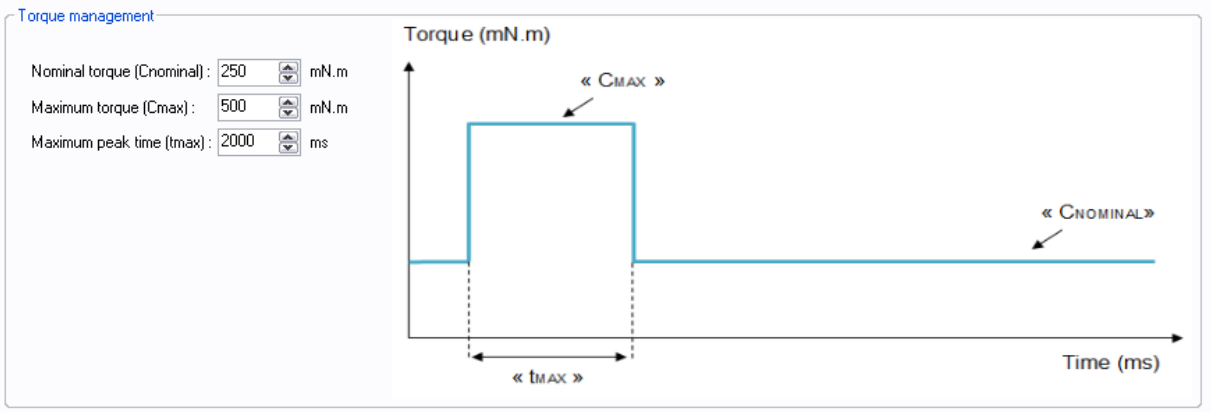


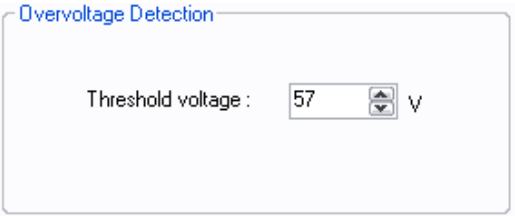
Figure 136

Setting the various torque parameters: When the application torque exceeds the torque "$C_{NOMINAL}$", the motor can provide torque up to the value "C_{MAX}" for the maximum duration "t_{MAX}". Thereafter, if the application torque is still higher than "$C_{NOMINAL}$", the motor torque is limited to the value "$C_{NOMINAL}$" until the application torque falls back below this value.

WARNING

VOLTAGE SURGES
During the braking phases, the motor generates voltage surges.
• Check that its voltage surges can be tolerated by the other devices connected to the same power supply.
• Use an external circuit to limit voltage surges if the brake is being used intensively.
Failure to comply with these precautions will result in death, serious injury or equipment damage.

Setting the overvoltage detection threshold parameters: If the voltage at the motor terminals exceeds this threshold, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).



12.1.6.9. "*Errors*" Tab Parameters

Setting the parameters for the action to be taken when an overtorque error is encountered: real torque higher than the nominal torque "$C_{NOMINAL}$" for a time longer than "t_{MAX}".

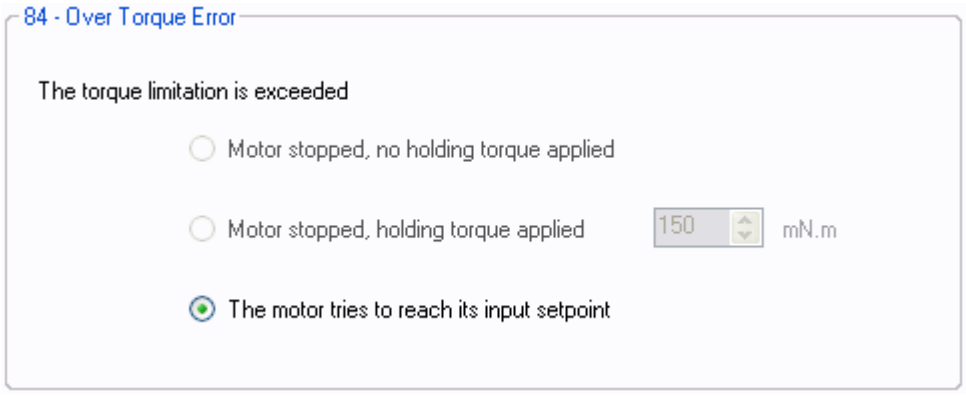


Figure 137

For all errors affecting motor safety, the action to be taken cannot be configured: in the event of an error, the motor is stopped and no holding torque is applied (freewheeling).

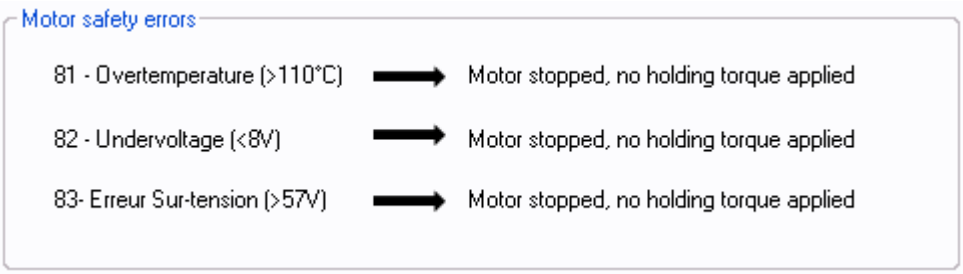


Figure 138

Procedure for restarting the motor following detection of an error:

- Eliminate the cause of the fault.
- Switch to stop mode: enable digital inputs 4 and 5.
- Switch back to run mode: disable either digital input 4 or digital input 5.

12.1.7. Expert Program V104

12.1.7.1. Description

Expert program V104 is used to:

- Create speed profiles with a choice of 8 preconfigured values.
- Set torque limiting with analog or PWM control.
- Set the acceleration/deceleration phase parameters via the HMI.

12.1.7.2. "*Inputs*" Tab Parameters

Combinations of digital inputs 1 to 3: Used to select the type of speed setpoint applied at the motor input: 8 possible combinations:

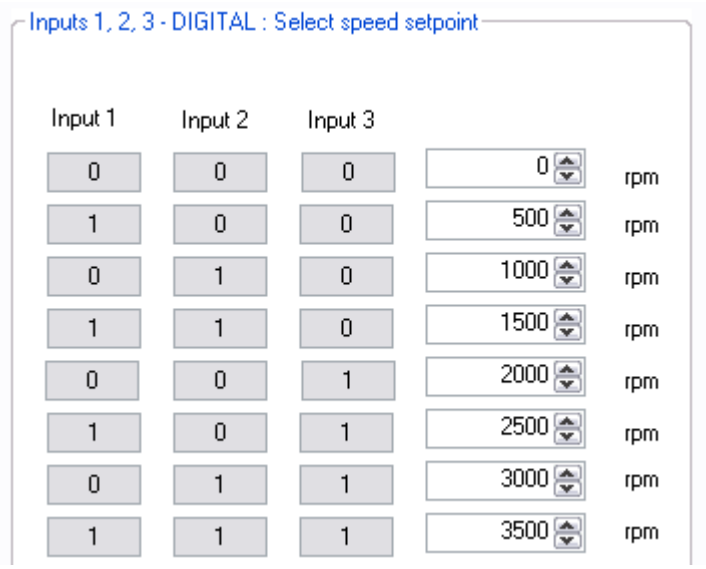
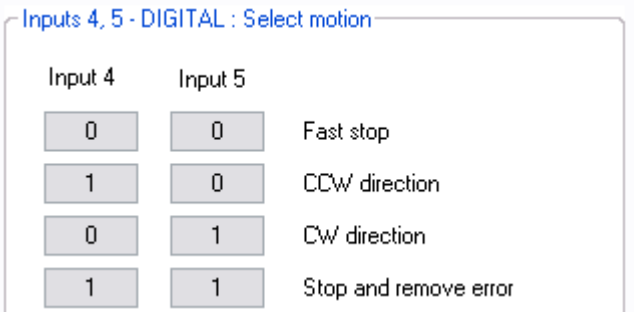

Inputs 1, 2, 3 - DIGITAL : Select speed setpoint
Input 1
Input 2
Input 3
0 0 0 0 rpm
1 0 0 500 rpm
0 1 0 1000 rpm
1 1 0 1500 rpm
0 0 1 2000 rpm
1 0 1 2500 rpm
0 1 1 3000 rpm
1 1 1 3500 rpm

Figure 139

Combinations of digital inputs 4 and 5: Used to select the motion to be performed from the 4 actions indicated below.



SEQ Figure * ARABIC 147

Setpoint input 6: Used to select the control type for the torque limiting setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

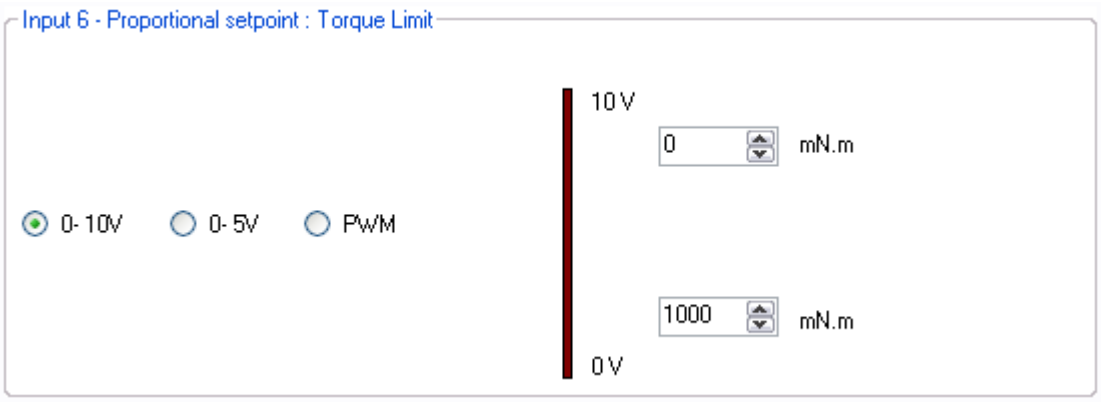


Figure 140

Setting the acceleration and braking ramps: These values are fixed via the HMI and cannot be changed by inputs while the motor is running. By default, the rates are fixed at 40,000 RPM/sec.

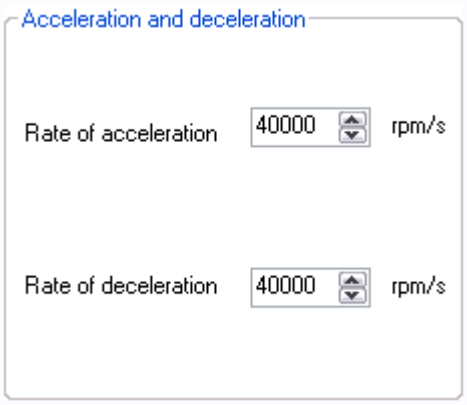


Figure 141

12.1.7.3. Type 1 "*Outputs*" Tab Parameters

Setting the parameters of Pulse output 1 "Real speed": A Hall pulse with configurable width (100 to 800 µs) is generated each time one of the 3 motor Hall sensors changes state.

80140_SMI21 and 80180_SMI21 motors have 12 Hall pulses per revolution (2 pairs of poles).
The 80280_SMI21 motor has 24 Hall pulses per revolution (4 pairs of poles).

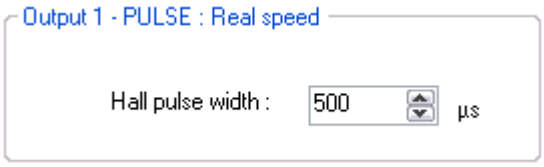


Figure 142

Setting the parameters of PWM output 2 "Real torque": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Torque supplied = "S2 torque".

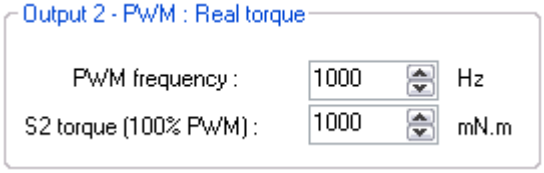


Figure 143

State of digital output 3 "Real direction": Used to find out the motor direction of rotation.

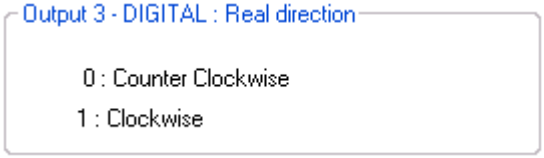


Figure 144

State of digital output 4 "Error": Used to find out whether an error has been detected.

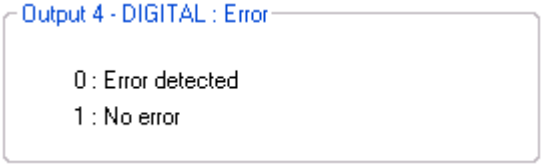


Figure 145

12.1.7.4. Type 2 "*Outputs*" Tab Parameters

Setting the parameters of PWM output 1 "Real speed": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Real speed = 0 rpm.
If cyclical ratio = 100% → Real speed = 4000 rpm.

Figure 146

Setting the parameters of PWM output 2 "Real torque": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Torque supplied = "S2 torque".

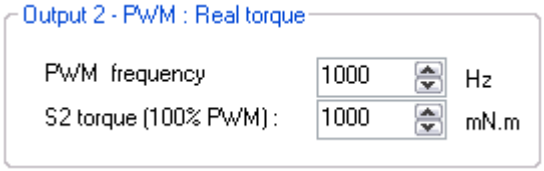


Figure 147

State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

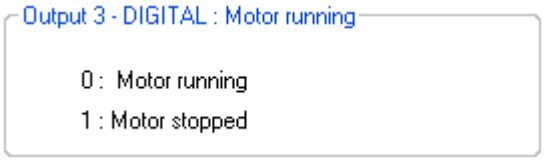


Figure 148

State of digital output 4 "Error": Used to find out whether an error has been detected.

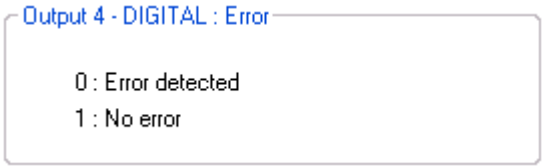


Figure 149

12.1.7.5. Type 3 "*Outputs*" Tab Parameters

Setting the parameters of frequency output 1 "Real speed": The parameters can be set for the signal frequency of this output for which the motor runs at 1000 RPM (200, 500 or 1000 Hz).

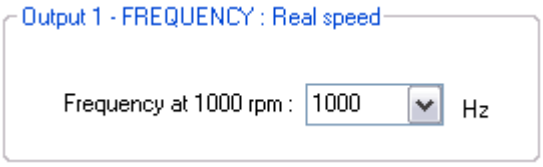


Figure 150

State of digital output 2 "Real direction": Used to find out the motor direction of rotation.

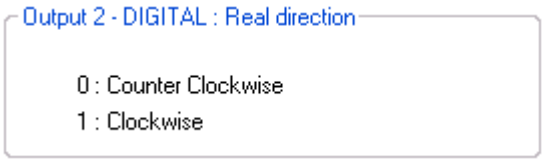


Figure 151

State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

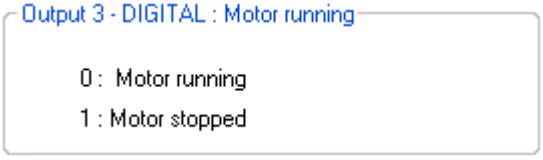


Figure 152

State of digital output 4 "Error": Used to find out whether an error has been detected.

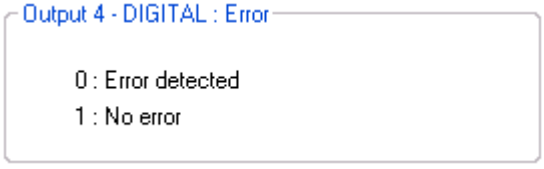


Figure 153

12.1.7.6. Type 4 "*Outputs*" Tab Parameters

Setting the parameters of PWM output 1: "Real speed (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Motor running forward (CW) at speed of 4000 rpm.
If cyclical ratio = 50% → Real speed = 0 rpm.
If cyclical ratio = 100% → Motor running in reverse (CCW) at speed of 4000 rpm.

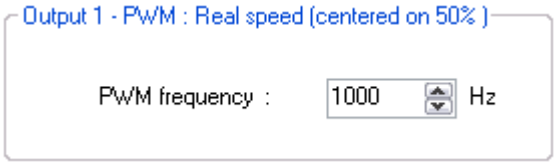


Figure 154

Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".
If cyclical ratio = 50% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

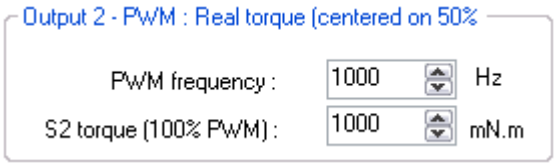


Figure 155

Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

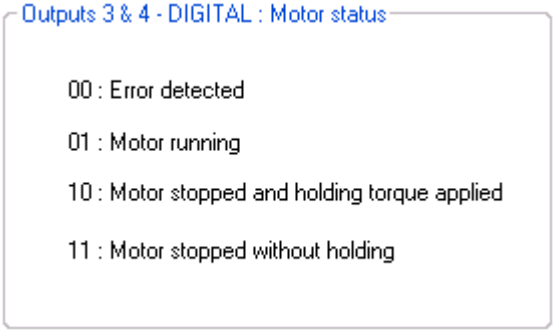

Outputs 3 & 4 - DIGITAL : Motor status
00 : Error detected
01 : Motor running
10 : Motor stopped and holding torque applied
11 : Motor stopped without holding

Figure 156

12.1.7.7. "*Tuning*" Tab Parameters

Selection of the various parameters to be represented in graphic form: either 1, 2 or 3 parameters. The system speed response (measurement vs setpoint) can therefore be compared while displaying changes in the current.

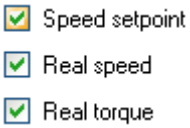


Figure 157

Set the PID controller factors in the speed control loop (this function is reserved for advanced users). The values given in the example below ensure correct product operation in the majority of cases.

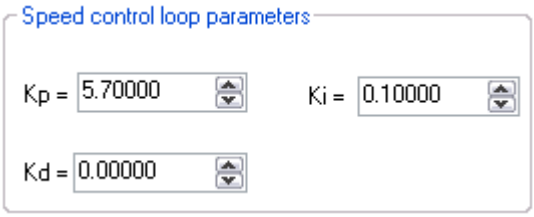


Figure 158

It is possible to set the recording time you wish to view, from 1 to 300 seconds.
The sampling interval is 10 ms.
During data acquisition, the other HMI functions are not available.

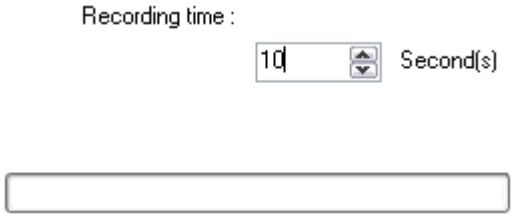


Figure 159

"Curve Drawing" button: used to start data acquisition. Curves are only displayed once acquisition is complete.

"Export Data" button: used to retrieve data corresponding to the selected parameters in a text file (*.txt*). To make this file compatible with the Excel spreadsheet, change its extension to .csv.

Figure 160

Example: With 8 preprogrammed speeds, this gives us the following graphic representation: (recording time of 30 seconds). Speed 1 is at 0 RPM.

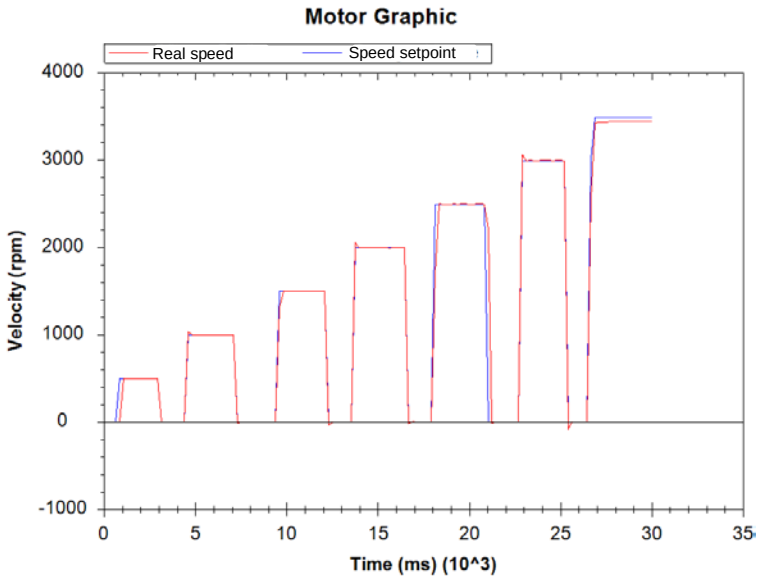


Figure 161

Note: The display scales can be changed with the mouse wheel. Other functions are available by right-clicking the mouse.

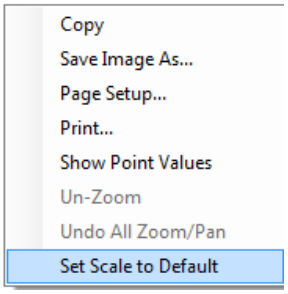


Figure 162

12.1.7.8. "*Limits*" Tab Parameters

WARNING
VOLTAGE SURGES During the braking phases, the motor generates voltage surges. • Check that its voltage surges can be tolerated by the other devices connected to the same power supply. • Use an external circuit to limit voltage surges if the brake is being used intensively. **Failure to comply with these precautions will result in death, serious injury or equipment damage.**

Setting the overvoltage detection threshold parameters: If the voltage at the motor terminals exceeds this threshold, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).

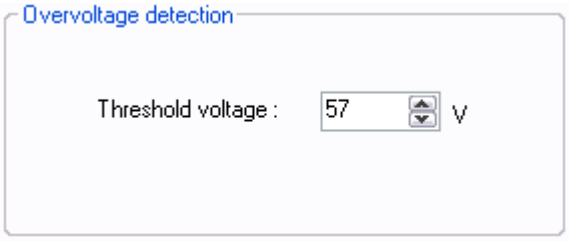


Figure 163

12.1.7.9. "*Errors*" Tab Parameters

For all errors affecting motor safety, the action to be taken cannot be configured: in the event of an error, the motor is stopped and no holding torque is applied (freewheeling).

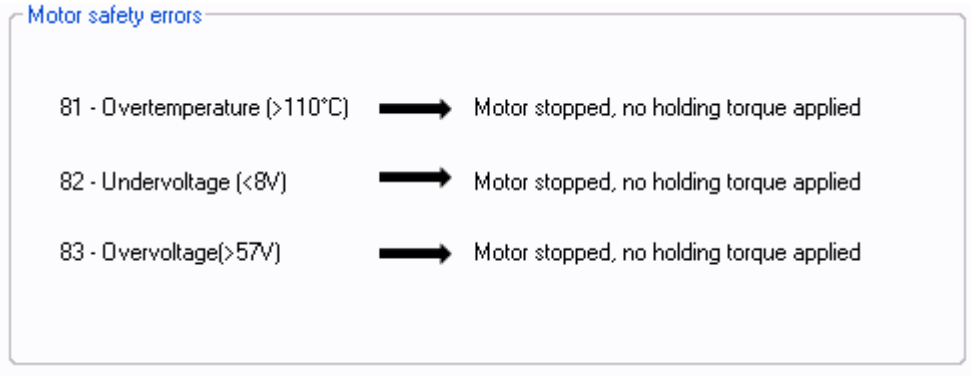


Figure 164

Procedure for restarting the motor following detection of an error:

- Eliminate the cause of the fault.
- Switch to stop mode: enable digital inputs 4 and 5.
- Switch back to run mode: disable either digital input 4 or digital input 5.

12.2. Position Programs

12.2.1. Types of Inputs in P100 Programs

The table below defines the function associated with each of the inputs in the 12 P100 programs (the color associated with the input number corresponds to that of the I/O bundle):

	Programs					
Inputs	**P101**	**P102**	**P103**	**P104**	**P105**	**P106**
In1	Position 1	Validation	Validation	Validation	Validation	Validation
In2	Position 2	1 to 8 positions	1 to 6 positions + Homing + ON/OFF	1 to 6 positions + Homing + ON/OFF	1 to 6 positions + Homing + ON/OFF	1 to 6 proportional positions + Homing + ON/OFF
In3	Position 3					
In4	Position 4					
In5	Homing	Homing	Speed ramps	Switch 1: limit stop	Switch 1: limit stop	Switch 1: limit stop
In6	ON/OFF	ON/OFF	Speed	Speed	Fast stop	Switch 2: limit stop

Inputs	**P107**	**P108**	**P109**	**P110**	**P111**	**P112**
In1	1 to 16 positions	Validation	Validation	Validation	1 to 30 positions + Homing + ON/OFF	1 to 30 proportional positions + Homing + ON/OFF
In2		1 to 14 positions + Homing + ON/OFF	1 to 14 positions + Homing + ON/OFF	1 to 14 positions + Homing + ON/OFF		
In3						
In4						
In5	Homing					
In6	ON/OFF	Speed	Switch 1: limit stop	Fast stop	Switch 1: limit stop	Switch 1: limit stop

Key:

- Digital type input
- Analog or PWM type input
- Forthcoming programs

12.2.2. Types of Outputs in P100 Programs

For all expert position programs, 5 configurable output configurations are available (the color associated with the output number corresponds to that of the I/O bundle):

	Out1	Out2	Out3	Out4
Type 5	On stand-by, target reached (if 1)	Homing phase complete (if 0)	Motor running (if 1)	Error (if 1)
	Digital	*Digital*	*Digital*	*Digital*
Type 6	On stand-by, target reached (if 1)	Homing phase complete (if 1)	Motor running (if 0)	Error (if 0)
	Digital	*Digital*	*Digital*	*Digital*
Type 7	On stand-by, target reached (if 1)	Real torque (centered on 50%)	00 : error detected 01 : homing not performed OR not completed 10 : motor stopped AND homing completed 11 : motor running (positioning)	
	Digital	*PWM*	*Digital combinations*	
Type 8	On stand-by, target reached (if 1)	Real torque (centered on 50%)	00 : error detected OR motor in stop mode AND homing not performed 01 : motor running (positioning) 10 : motor stopped AND homing completed 11 : not used	
	Digital	*PWM*	*Digital combinations*	
Type 9	Hall pulse	Direction of rotation	00 : error detected OR motor in stop mode 01 : not used 10 : motor stopped AND target reached 11 : motor running (positioning)	
	pulse	*Digital*	*Digital combinations*	

Key: Digital type output

PWM/Pulse/Frequency type output

12.2.3. Description of the Different Types of Homing

The homing sequence is an initialization phase that helps the motor estimate the application total stroke by searching for mechanical stops. These stops can be detected in one of 2 ways:

- With 1 limit switch by retrieving information from one of the inputs.
- By detecting overtorque when the motor is at a mechanical stop.

N.B.: The default motor direction of rotation is forward (CW).

12.2.3.1. Homing Phase Without a Switch

a) Start from current position:

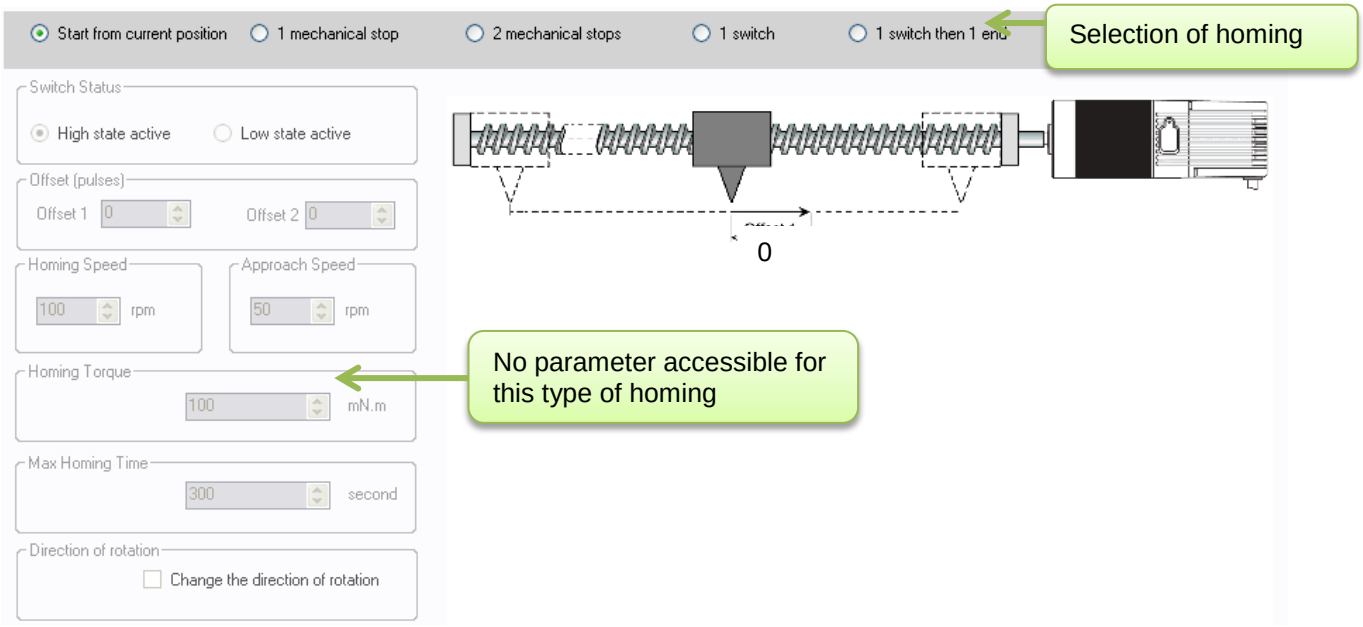


Figure 165

When the homing sequence starts, the current position is used as a reference (position 0).

b) 1 mechanical stop:

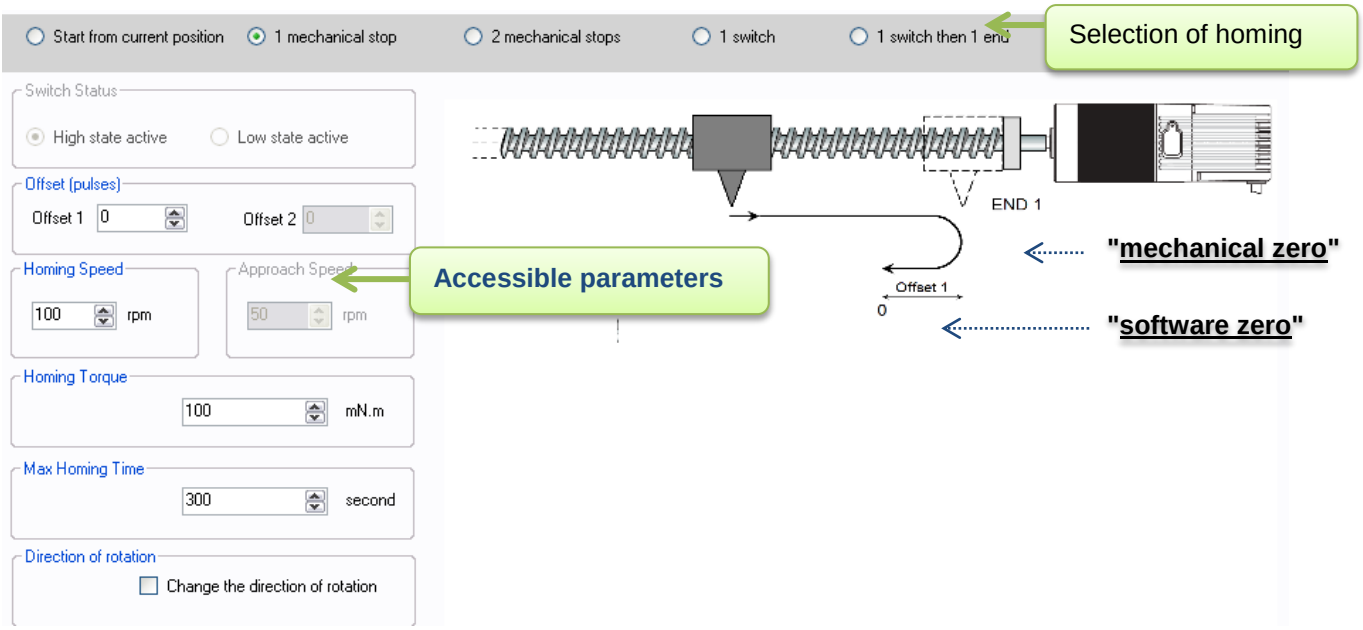


Figure 166

This homing phase is used to search for the system mechanical stop as follows:

- Depending on the "END1" stop position (on the right or left), the user selects the appropriate "**Direction of rotation**" and sets a "**Homing Speed**".

- When the application torque increases to more than the "**Homing Torque**", the "END1" mechanical stop is detected, the motor is in the "**mechanical zero**" position.

- To avoid the motor coming into contact with the "END1" mechanical stop each time it returns to the reference position, "**Offset 1**" can be set (in encoder pulses).

- This new position should be considered as the reference position. The motor positions itself at "**software zero**": the homing phase is complete.

- As a safety measure, if the homing phase is not complete after the "**Max Homing Time**", the motor detects a "Homing" type error and stops.

c) 2 mechanical stops:

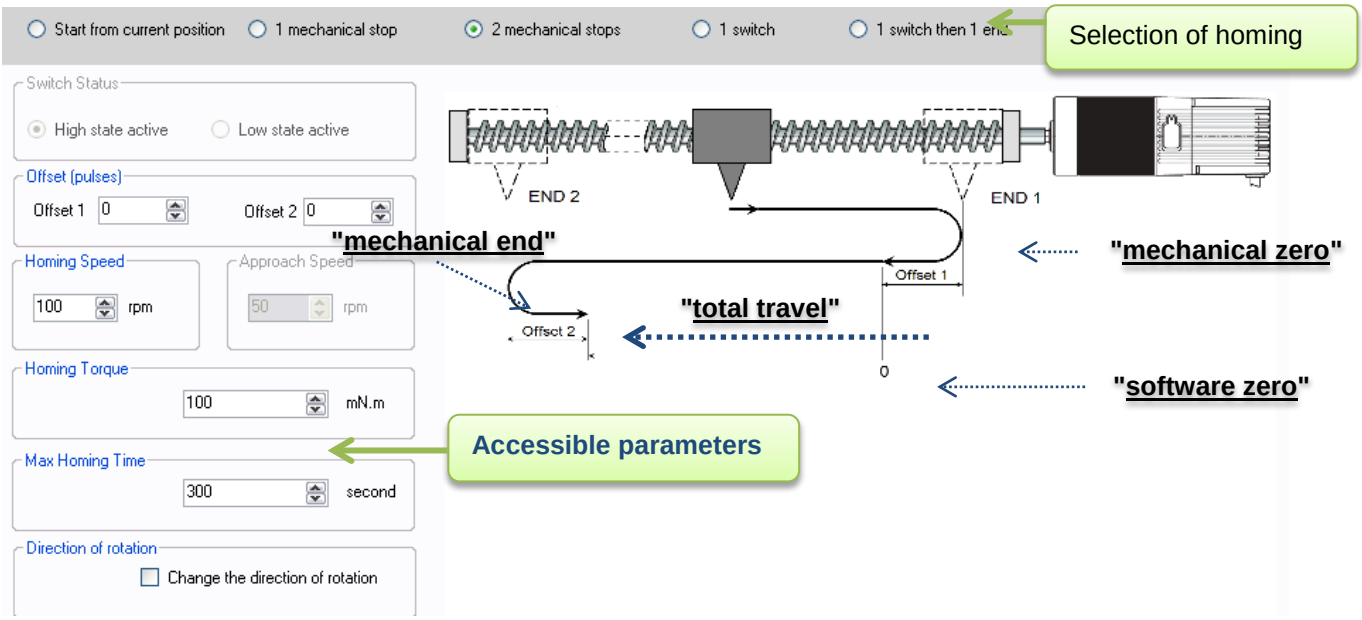


Figure 167

This homing phase is used to search for the 2 system mechanical stops as follows:

- Depending on the 1st "END1" stop position (on the right or left), the user selects the appropriate "**Direction of rotation**" and sets a "**Homing Speed**".
- When the application torque increases to more than the "**Homing Torque**", the "END1" mechanical stop is detected, the motor is in the "**mechanical zero**" position.
- To avoid the motor coming into contact with the "END1" mechanical stop each time it returns to the reference position, "**Offset 1**" can be set (in encoder pulses) which gives us the difference in position between the "**mechanical zero**" and the "**software zero**".
- The motor then travels in the opposite direction to find the 2nd mechanical stop "END2". The "END2" mechanical stop is detected in a similar way. The motor is in the "**mechanical end**" position.
- To avoid the motor coming into contact with the "END2" mechanical stop each time it returns to the reference position, "**Offset 2** " can be set (in encoder pulses) which gives us the difference in position between the "**mechanical end**" and the "**total stroke**".
- After detecting both mechanical stops, the motor positions itself at (END2 – offset 2): the homing phase is complete.
- As a safety measure, if the homing phase is not complete after the "**Max Homing Time**", the motor detects a "Homing" type error and stops.

12.2.3.2. Homing Phase With 1 Switch

a) 1 switch:

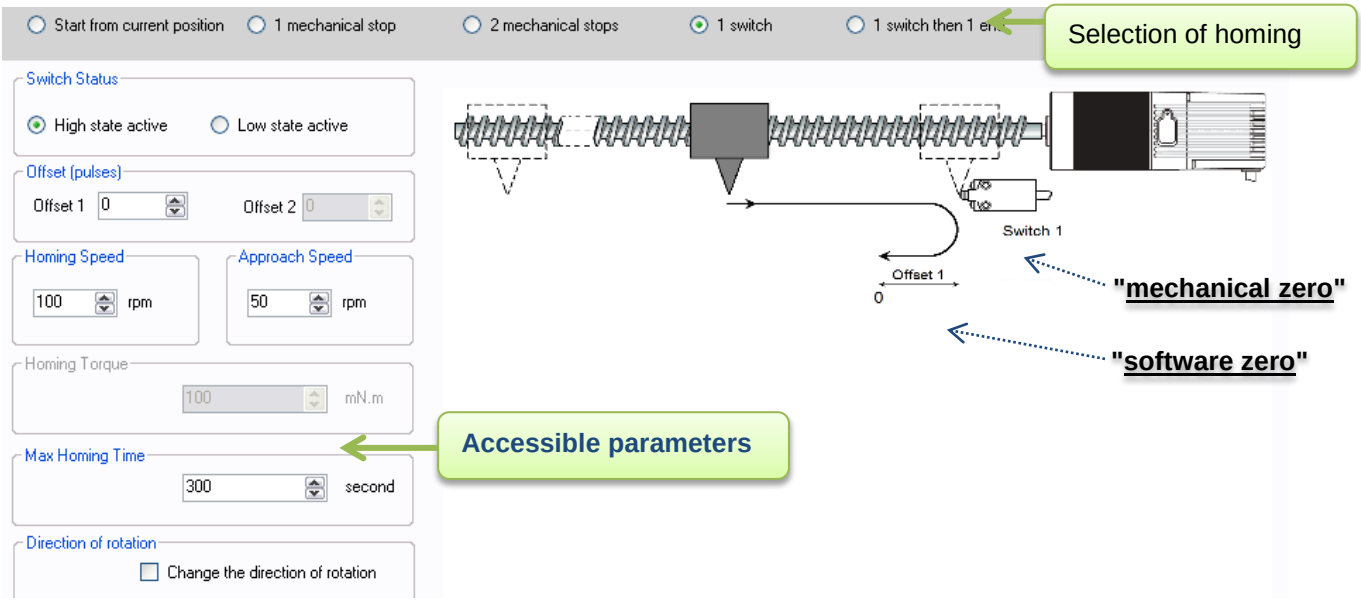


Figure 168

This homing phase is used to search for the system "switch" type stop as follows:

- First configure the switch polarity: « **High state active** " or "**Low state active** ".
- Depending on the switch position (on the right or left), the user selects the appropriate "**Direction of rotation**" and sets a " **Homing Speed**".
- When the switch changes state, the "Switch 1" stop is detected. The motor is in the "**mechanical zero**" position.
- To avoid the motor coming into contact with the switch each time it returns to the reference position, " **Offset 1**" can be set (in encoder pulses).
- This new position should be considered as the reference position. The motor positions itself at "**software zero**": the homing phase is complete.
- As a safety measure, if the homing phase is not complete after the "**Max Homing Time**", the motor detects a "Homing" type error and stops.

b) 1 switch then 1 end: with the zero defined by the switch

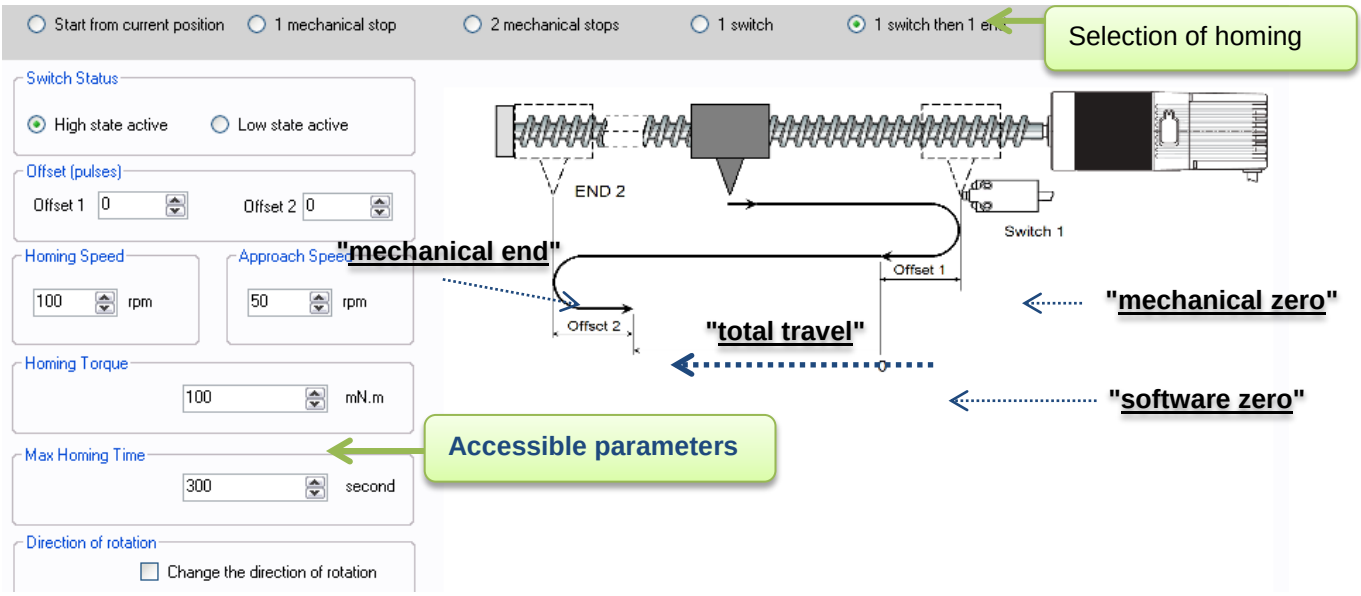


Figure 169

This homing phase is used to search initially for the system "switch" type stop, then for the system mechanical stop as follows:

- First configure the switch polarity: « **High state active** " or "**Low state active** ".
- Depending on the switch position (on the right or left), the user selects the appropriate "**Direction of rotation**" and sets a " **Homing Speed**".
- When the switch changes state, the first stop "Switch 1" is detected. The motor is in the "**mechanical zero**" position.
- To avoid the motor coming into contact with the "Switch 1 " stop each time it returns to the reference position, " **Offset 1**" can be set (in encoder pulses) which gives us the difference in position between the "**mechanical zero**" and the "**software zero**".
- The motor then travels in the opposite direction to find the 2nd mechanical stop "END2".
- When the application torque increases to more than the "**Homing Torque**", the "END2" mechanical stop is detected, the motor is in the "**mechanical zero**" position.
- To avoid the motor coming into contact with the "END2" mechanical stop each time it returns to the reference position, "**Offset 2** " can be set (in encoder pulses) which gives us the difference in position between the "**mechanical end**" and the "**total stroke**".
- After detecting both stops, the motor positions itself at (END2 – offset 2): the homing phase is complete.
- As a safety measure, if the homing phase is not complete after the "**Max Homing Time**", the motor detects a "Homing" type error and stops.

c) 1 end then 1 switch: with the zero defined by the mechanical switch

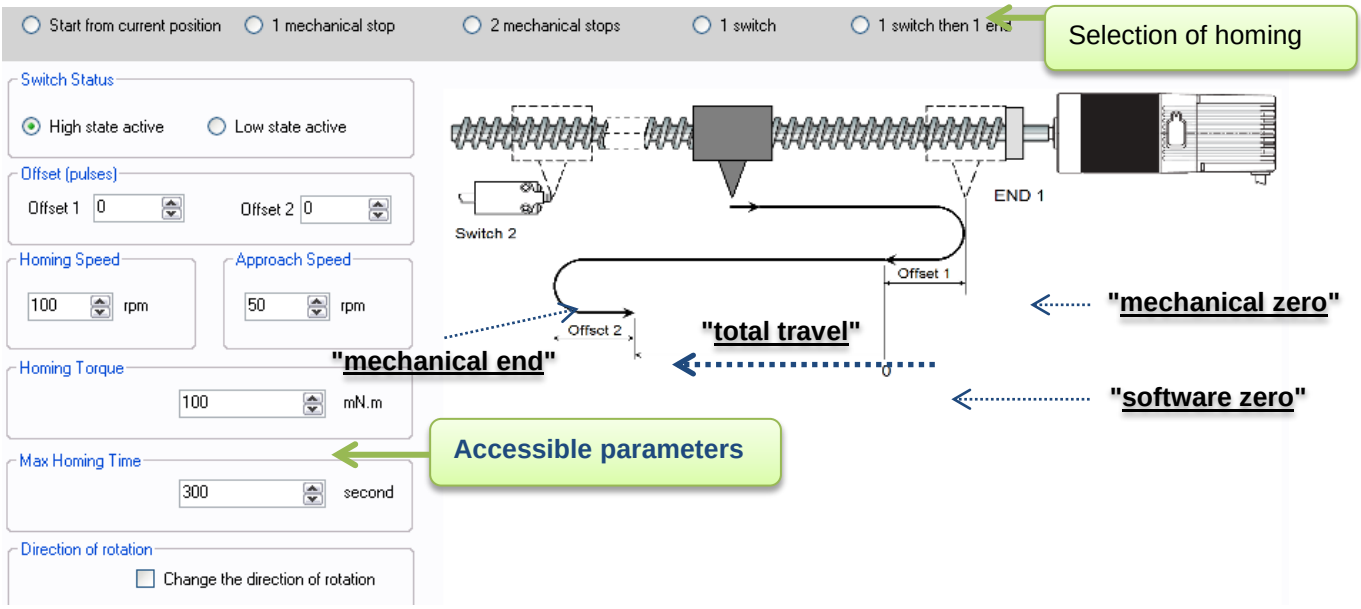


Figure 170

This homing phase is used to search initially for the system mechanical stop, then for the system "switch" type stop as follows:

- First configure the switch polarity: « **High state active** " or "**Low state active** ".
- Depending on the "END1" stop position (on the right or left), the user selects the appropriate "**Direction of rotation**» and sets a "**Homing Speed**".
- When the application torque increases to more than the "**Homing Torque**", the "END1" mechanical stop is detected, the motor is in the "**mechanical zero**" position.
- To avoid the motor coming into contact with the "END1" mechanical stop each time it returns to the reference position, "**Offset 1**" can be set (in encoder pulses) which gives us the difference in position between the "**mechanical zero**" and the "**software zero**".
- The motor then travels in the opposite direction to find the 2nd stop "Switch 2".
- When the switch changes state, the 2nd stop "Switch 2" is detected, the motor is in the "**mechanical end**" position.
- To avoid the motor coming into contact with the "Switch 2" stop each time it returns to the reference position, " **Offset 2**" can be set (in encoder pulses) which gives us the difference in position between the "**mechanical end**" and the "**total stroke**".
- After detecting both stops, the motor positions itself at (Switch 2 – offset 2): the homing phase is complete.
- As a safety measure, if the homing phase is not complete after the "**Max Homing Time**", the motor detects a "Homing" type error and stops.

12.2.4. Description of the Various Tabs

For the description of tabs, expert program P101 is used as an example (for detailed information about each speed expert program, see the "Expert Program P101" to "Expert Program P111" sections in this document).

12.2.4.1. Home Page

This page is common to all the expert and application programs, whether in speed, position or torque mode. It can be used to choose between the various types of application and expert programs.

In our example, we have chosen the "Position P100" category in the "Expert Programs" group, so the icons for the various P100 expert programs appear in the bottom right-hand corner of the window, and you then need to click on the one corresponding to the "P101" expert program:

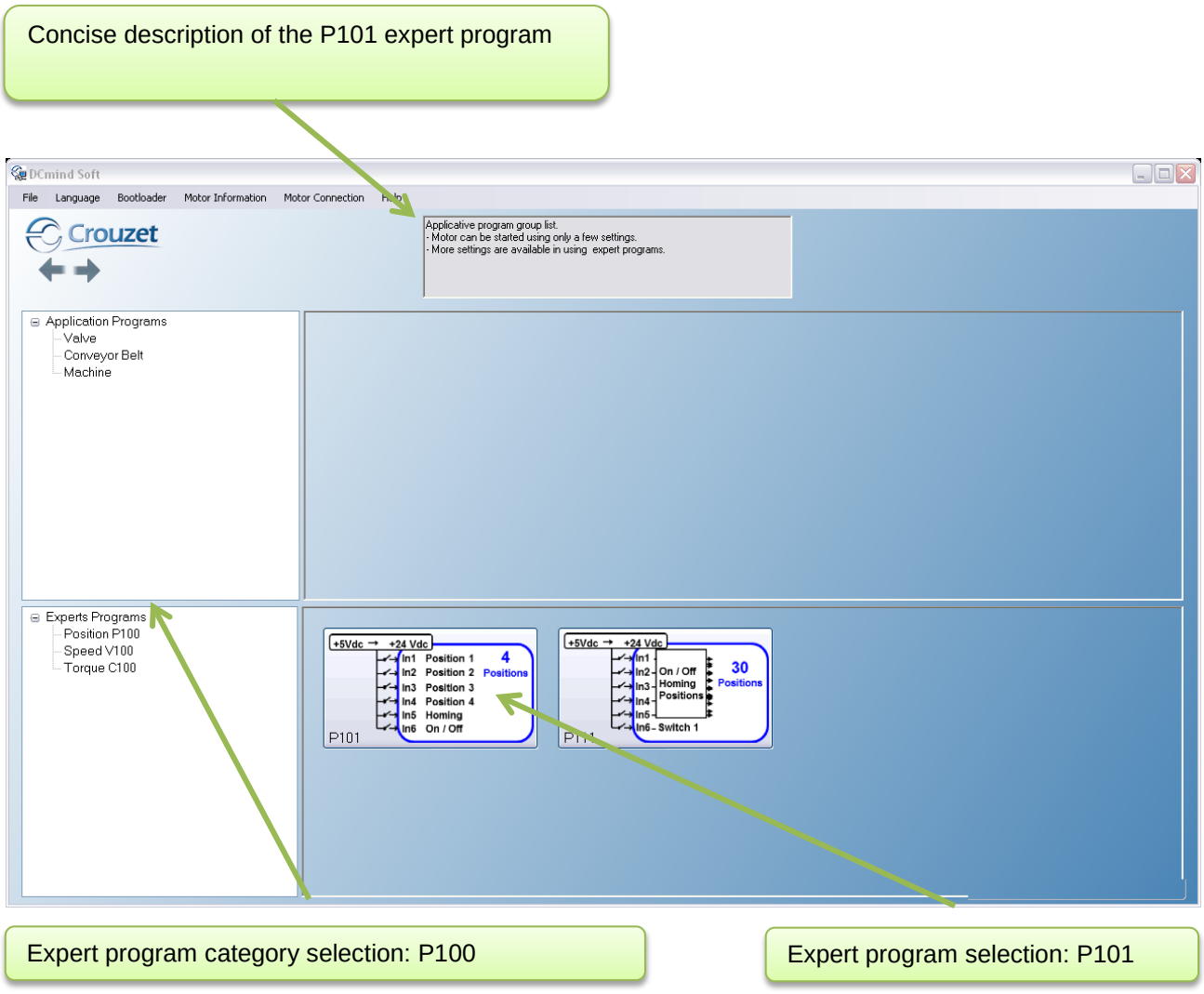
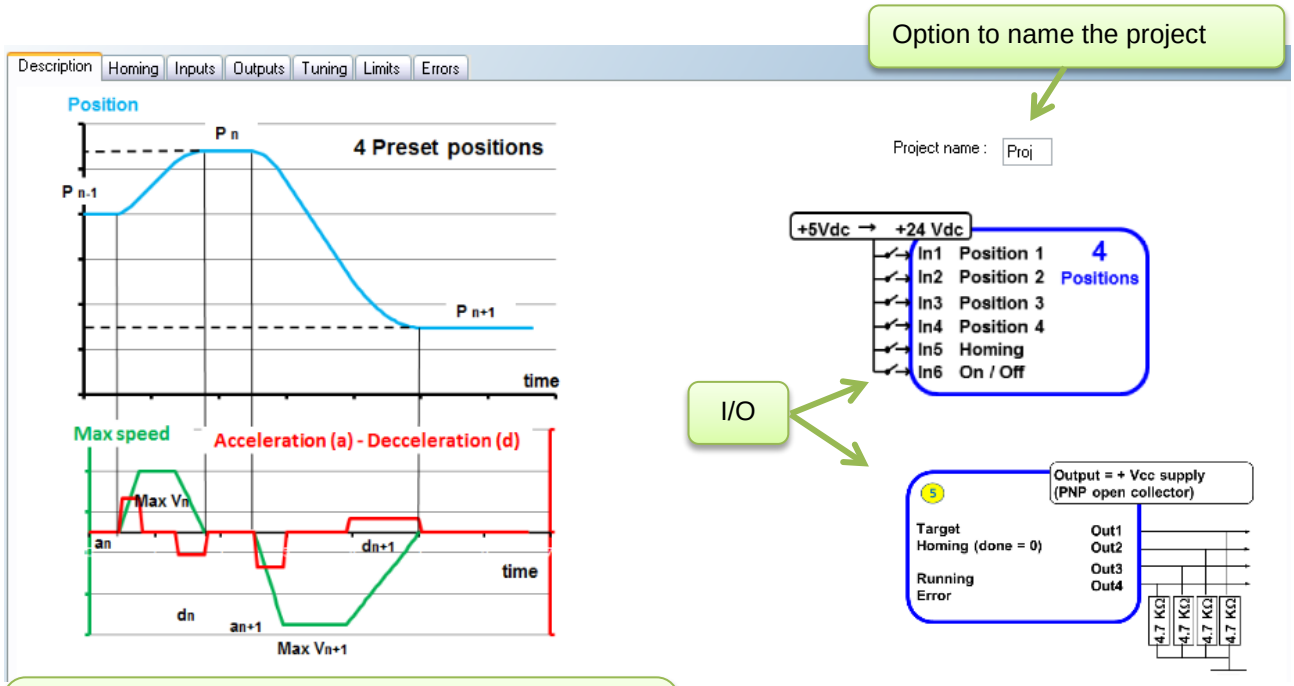


Figure 171

12.2.4.2. "Description" Tab

This is an information tab containing a concise description of the various position profiles that are created using this expert mode:

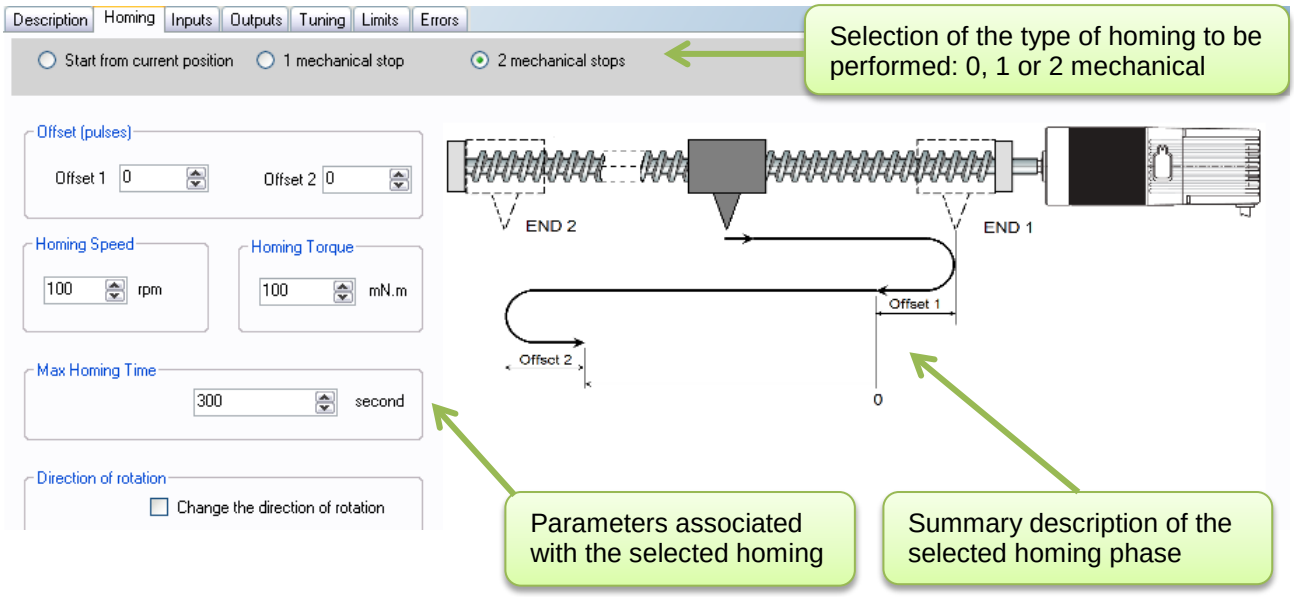


Summary description of the profiles that can be created using this expert mode: positioning with 4 predefined targets, acceleration ramps, etc.

Figure 172

12.2.4.3. "Homing" Tab

This tab is used to select and configure the type of homing to be performed: offset(s), speed, homing torque, maximum duration of the homing phase, motor direction of rotation to search for the 1st stop.



12.2.4.4. "Inputs" Tab

This tab is used to configure the various inputs in this expert mode (digital input polarity, setting the parameters for the 4 target positions: position, maximum speed, acceleration and deceleration rates).

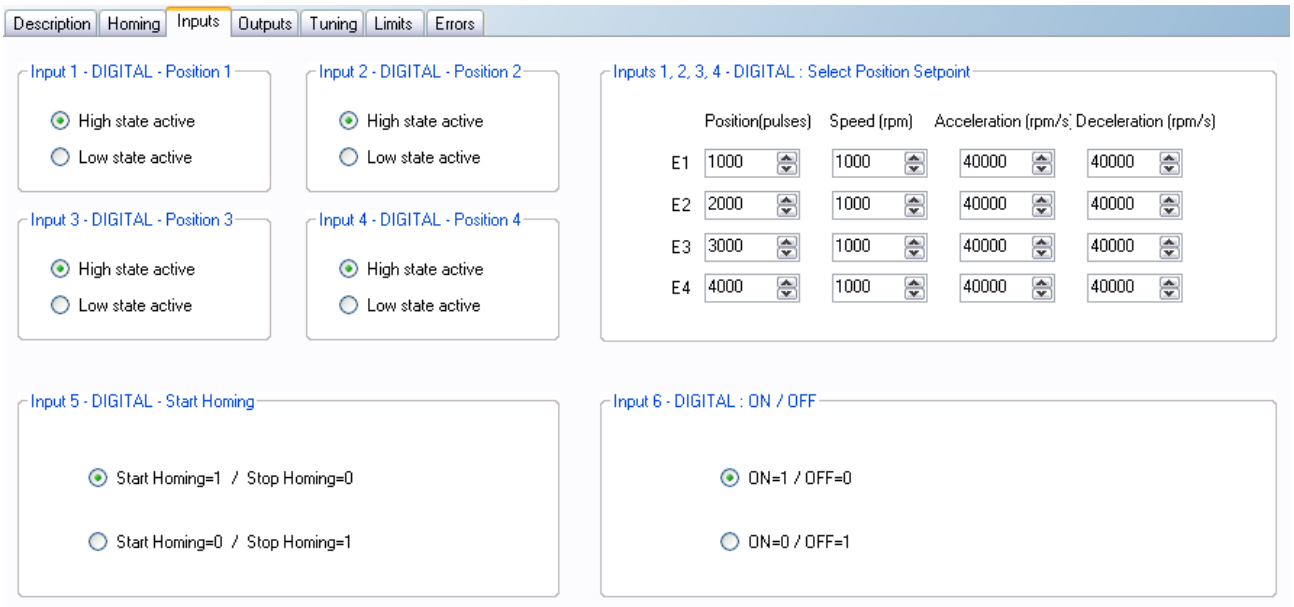


Figure 174

12.2.4.5. "Outputs" Tab

This tab is used to select and configure the various outputs in this expert mode (position type 5 to type 9):

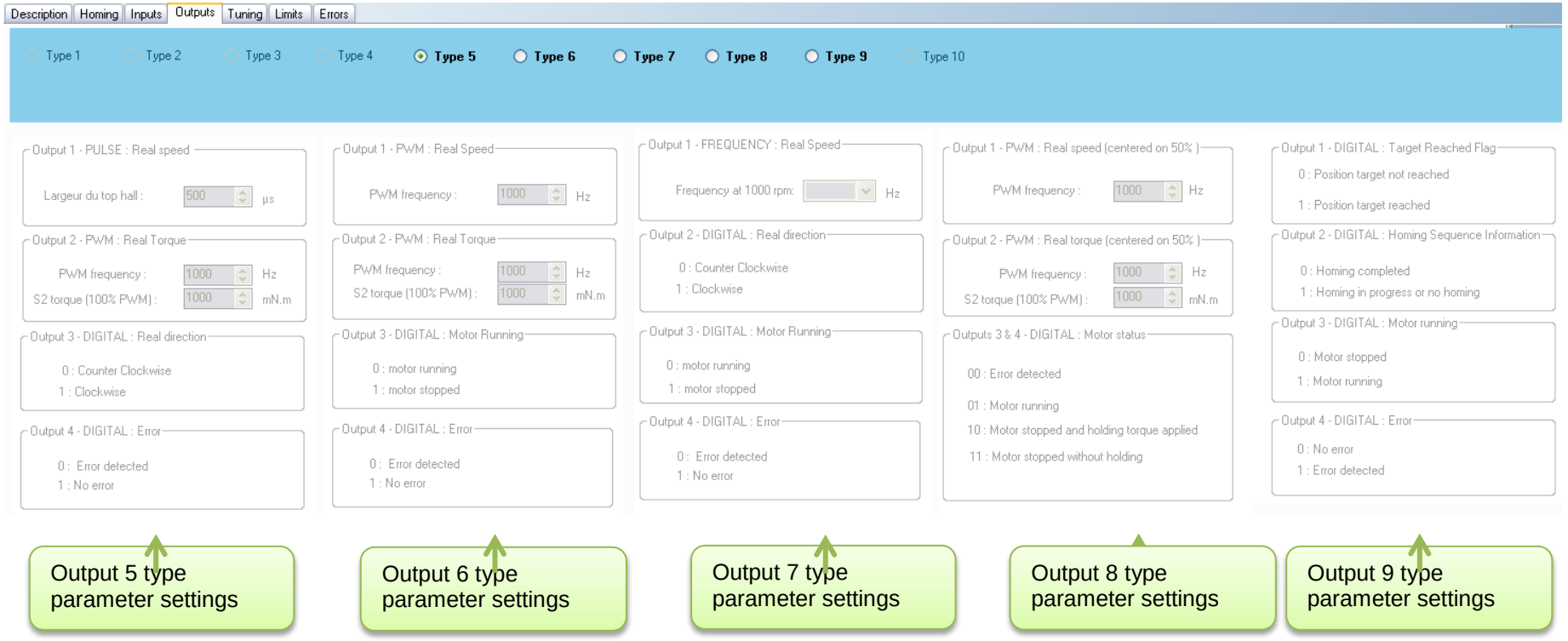


Figure 175

12.2.4.6. "Tuning" Tab

This tab is used to represent some parameters (speed, position, torque, etc.) in graphic form and modify the position control loop coefficients. It is common to all the position expert programs.

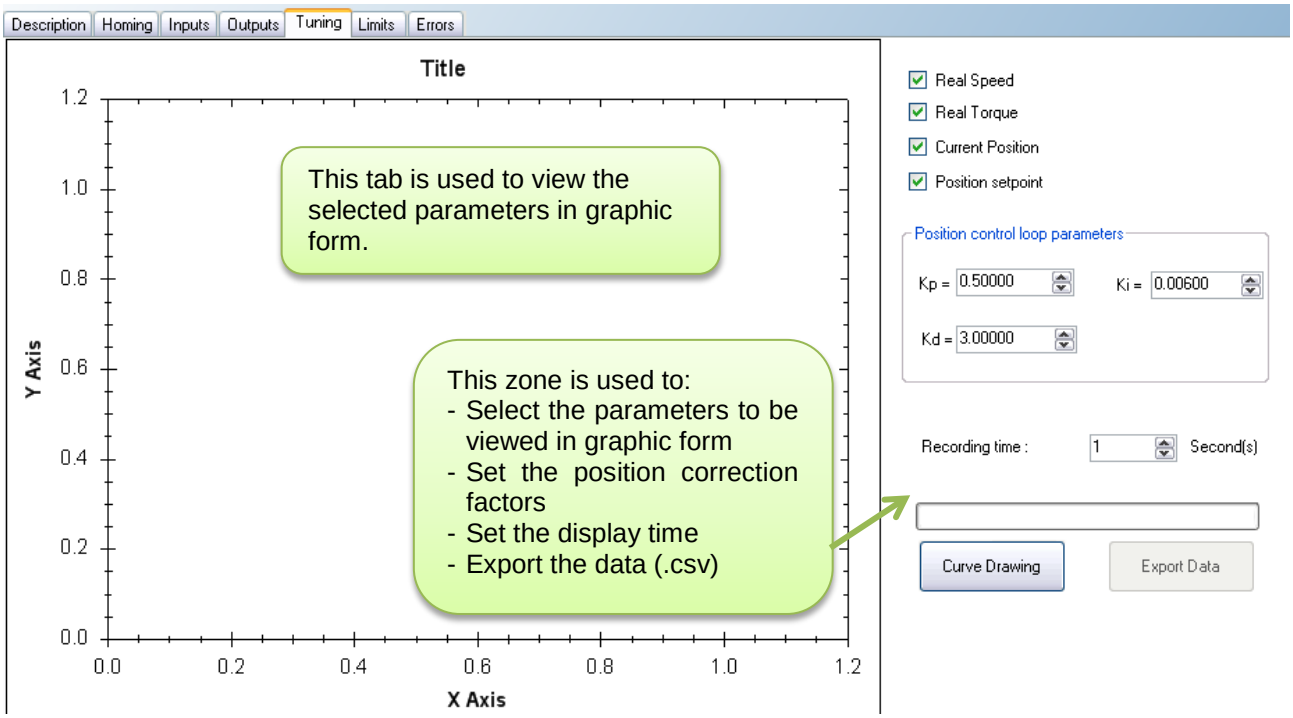
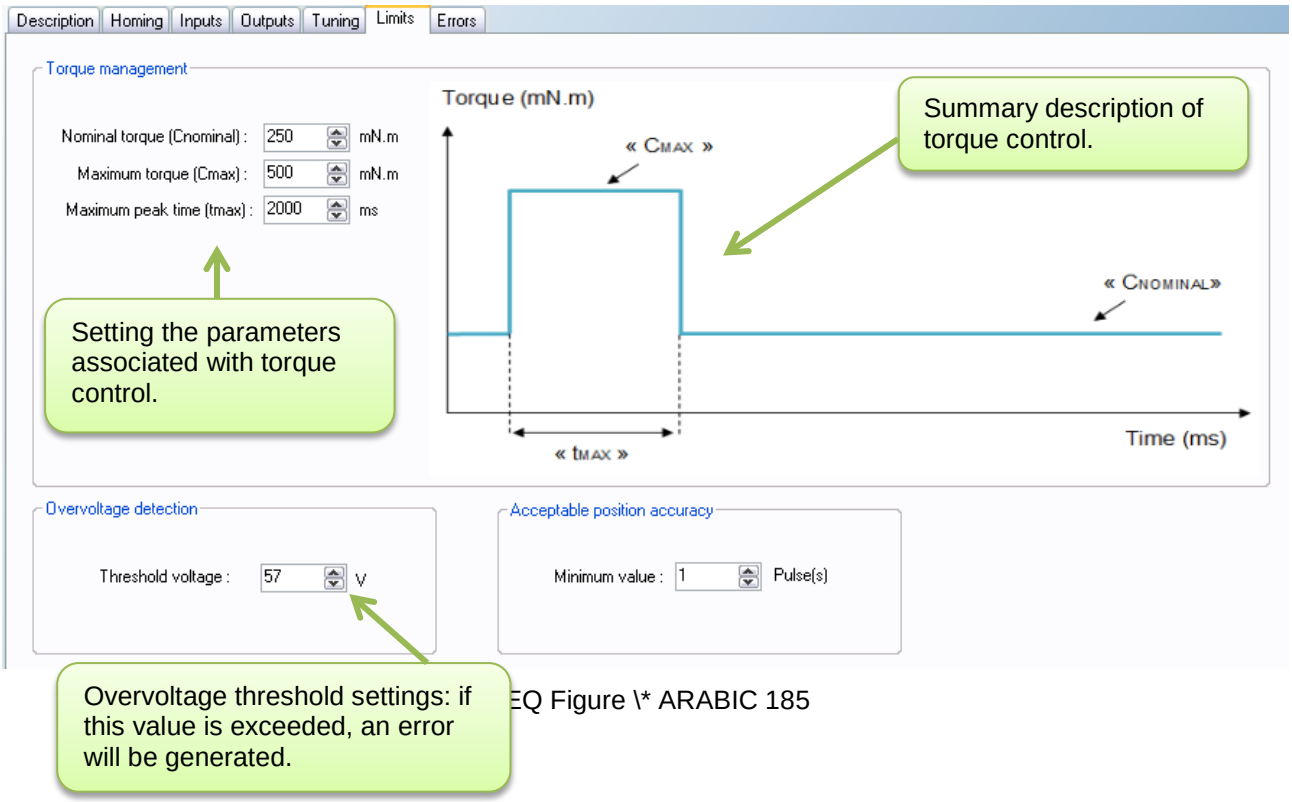


Figure 176

12.2.4.7. "Limits" Tab

This tab is used to configure the various motor operating limits: nominal and maximum torque (torque peak authorization) and the power supply overvoltage threshold.

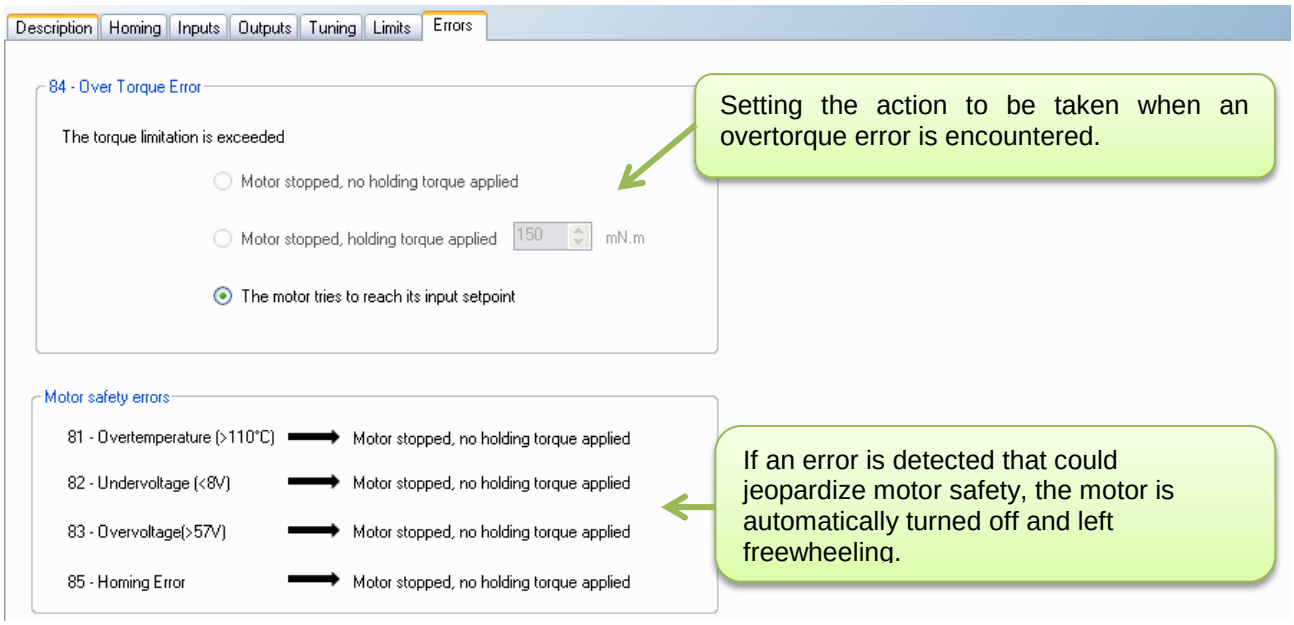


EQ Figure * ARABIC 185

12.2.4.8. "Errors" Tab

This tab provides information about the type of error encountered (based on the error code) and the action to be taken by the motor following this error.

Action for the overtorque error can be configured.


Description
Homing
Inputs
Outputs
Tuning
Limits
Errors
84 - Over Torque Error
The torque limitation is exceeded
Motor stopped, no holding torque applied
Motor stopped, holding torque applied
150
mN.m
The motor tries to reach its input setpoint
Setting the action to be taken when an overtorque error is encountered.
Motor safety errors
81 - Overtemperature (>110°C)
Motor stopped, no holding torque applied
82 - Undervoltage (<8V)
Motor stopped, no holding torque applied
83 - Overvoltage(>57V)
Motor stopped, no holding torque applied
85 - Homing Error
Motor stopped, no holding torque applied
If an error is detected that could jeopardize motor safety, the motor is automatically turned off and left freewheeling.

Procedure for restarting the motor following detection of an error:

- Eliminate the cause of the fault.
- Switch to stop mode and then back to run mode.

Figure 177

12.2.5. Expert Program P101

12.2.5.1. Description

Expert program P101 is used to:

- Perform a homing phase to initialize the system with detection of the limit switches.

- Perform various positionings using 4 preset setpoint positions, each corresponding to one of the digital inputs "In1" to "In4".

- Set the acceleration/deceleration phases and the maximum speed that must not be exceeded between each point via the HMI.

12.2.5.2. "*Homing*" Tab Parameters

Set the difference in position (in pulses) between the mechanical stops and the application total stroke limits: stop 1 (END1) represents the stroke start, stop 2 (END2) represents the stroke end.

Note: Where there is only one mechanical stop, the "Offset 2" parameter is not available.

Figure 178

Set the search speed for stops during the homing phase.

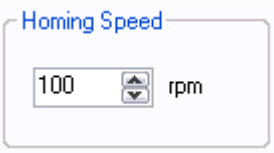


Figure 179

Set the homing torque that allows the mechanical stop to be found by detection of overtorque.

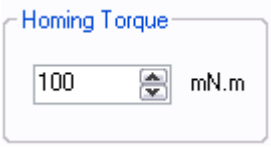


Figure 180

Set the maximum permitted time for the homing phase. If this value is exceeded, an error will be generated. Time limited to 300 seconds.

Figure 181

Set the direction of rotation for the first stop search (END1).

N.B.: By default, the motor runs forward (CW).

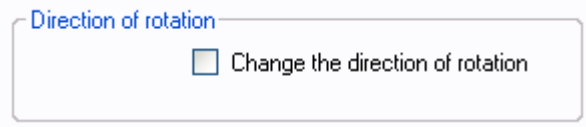


Figure 182

12.2.5.3. "*Inputs*" Tab Parameters

Digital input 1: Used to set the "Position 1" input polarity.

Figure 183

Digital input 2: Used to set the "Position 2" input polarity.

Figure 184

Digital input 3: Used to set the "Position 3" input polarity.

Figure 185

Digital input 4: Used to set the "Position 4" input polarity.

Figure 186

Set the 4 position setpoints and the speed profiles to be followed (acceleration ramp, speed step and deceleration ramp: trapezoidal profile):

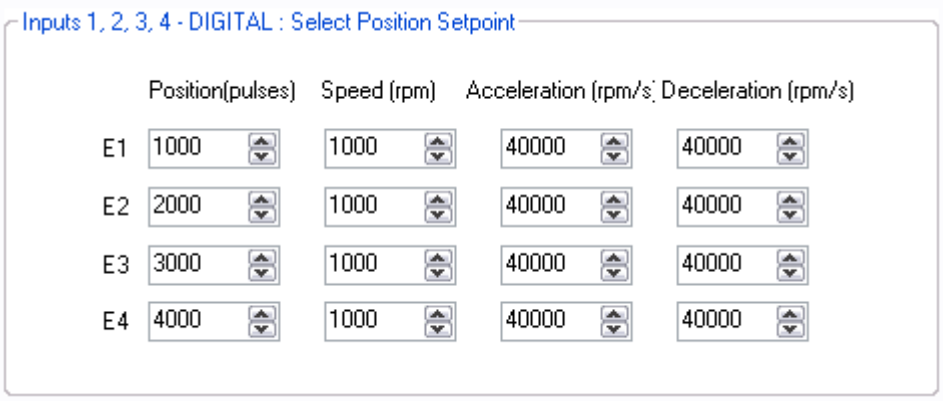

Inputs 1, 2, 3, 4 - DIGITAL : Select Position Setpoint
Position(pulses)
Speed (rpm)
Acceleration (rpm/s)
Deceleration (rpm/s)
E1 1000 1000 40000 40000
E2 2000 1000 40000 40000
E3 3000 1000 40000 40000
E4 4000 1000 40000 40000

Figure 187

Digital input 5: Used to set the "Start Homing" input polarity.

Figure 188

Digital input 6: Used to set the "On/Off" input polarity.

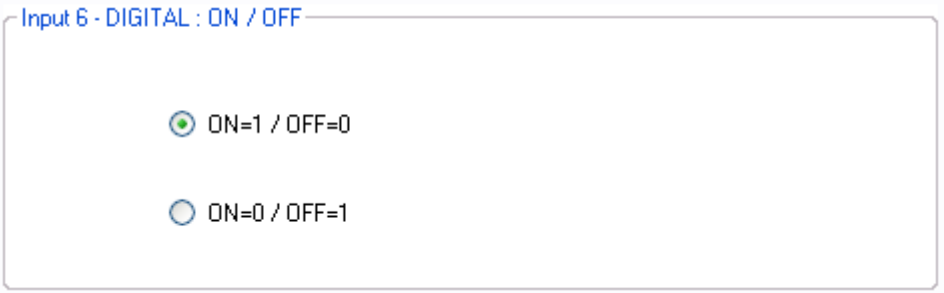


Figure 189

12.2.5.4. Type 5 "*Outputs*" Tab Parameters

State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.

Figure 190

State of digital output 2 "Homing Sequence Information": Used to find out how the homing phase is progressing: completed, in progress or not performed.

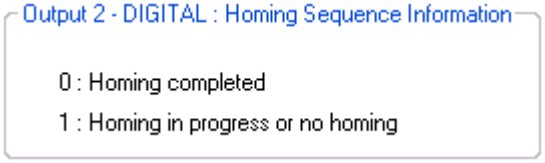


Figure 191

State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

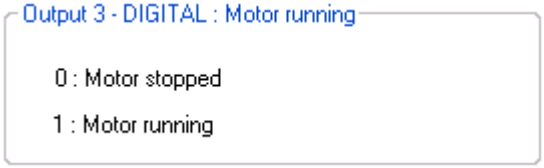


Figure 192

State of digital output 4 "Error": Used to find out whether an error has been detected.

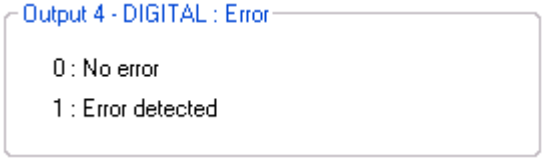


Figure 193

12.2.5.5. Type 6 "*Outputs*" Tab Parameters

State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.

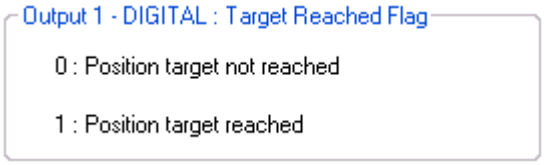


Figure 194

State of digital output 2 "Homing Sequence Information": Used to find out how the homing phase is progressing: completed, in progress or not performed.

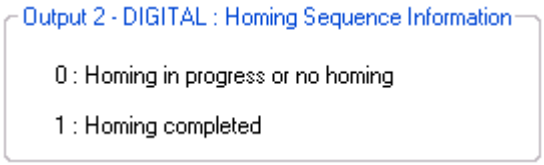


Figure 195

State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

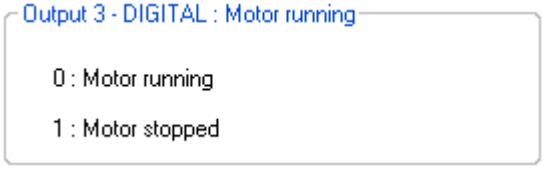


Figure 196

State of digital output 4 "Error": Used to find out whether an error has been detected.

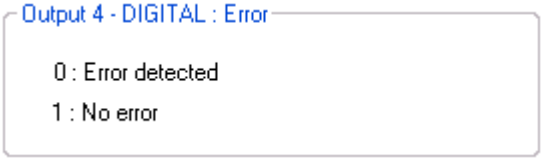


Figure 197

12.2.5.6. Type 7 "*Outputs*" Tab Parameters

State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.

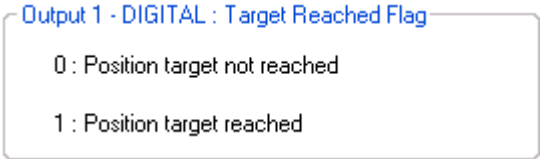


Figure 198

Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".
If cyclical ratio = 50% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

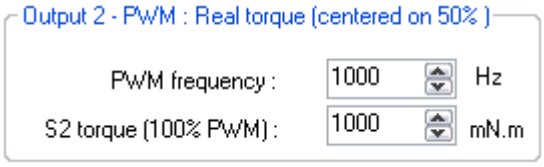


Figure 199

Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

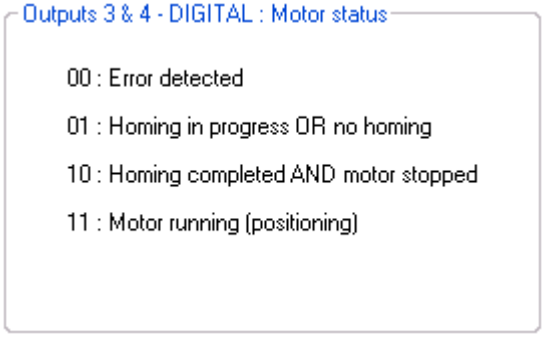

Outputs 3 & 4 - DIGITAL : Motor status
00 : Error detected
01 : Homing in progress OR no homing
10 : Homing completed AND motor stopped
11 : Motor running (positioning)

Figure 200

12.2.5.7. Type 8 "*Outputs*" Tab Parameters

State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.

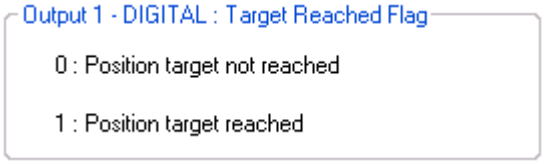


Figure 201

Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".
If cyclical ratio = 50% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

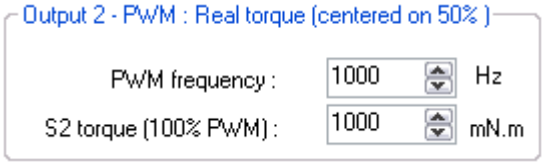


Figure 202

Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

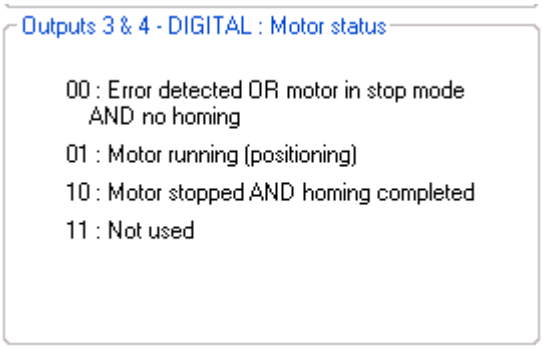

Outputs 3 & 4 - DIGITAL : Motor status
00 : Error detected OR motor in stop mode AND no homing
01 : Motor running (positioning)
10 : Motor stopped AND homing completed
11 : Not used

Figure 203

12.2.5.8. Type 9 "*Outputs*" Tab Parameters

Setting the parameters of Pulse output 1 "Real speed": A Hall pulse with configurable width (100 to 800 µs) is generated each time one of the 3 motor Hall sensors changes state.

80140_SMI21 and 80180_SMI21 motors have 12 Hall pulses per revolution (2 pairs of poles).
The 80280_SMI21 motor has 24 Hall pulses per revolution (4 pairs of poles).

Figure 204

State of digital output 2 "Real direction": Used to find out the motor direction of rotation.

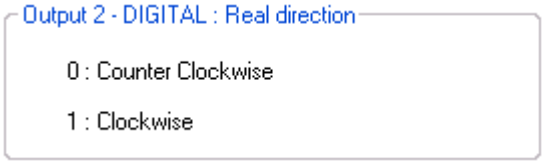


Figure 205

Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

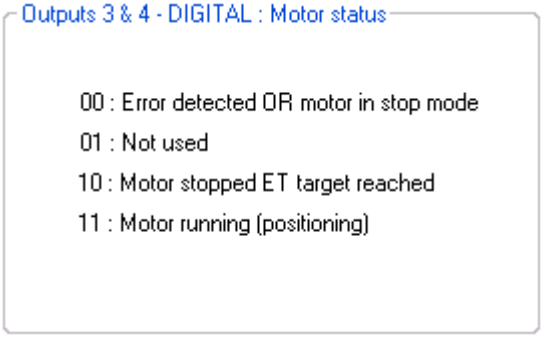

Outputs 3 & 4 - DIGITAL : Motor status
00 : Error detected OR motor in stop mode
01 : Not used
10 : Motor stopped ET target reached
11 : Motor running (positioning)

Figure 206

12.2.5.9. "*Tuning*" Tab Parameters

Selection of the various parameters to be represented in graphic form: either 1, 2, 3 or 4 parameters. The system position response (measurement vs setpoint) can therefore be compared while displaying changes in the current and the speed.

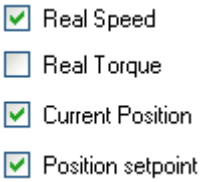


Figure 207

Set the PID controller factors in the position control loop (this function is reserved for advanced users). The values given in the example below ensure correct product operation in the majority of cases.

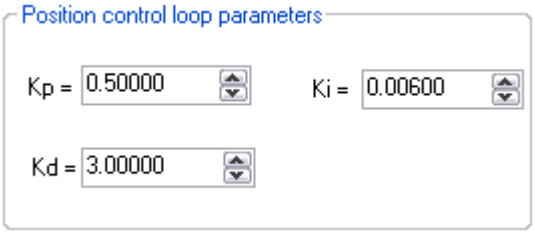


Figure 208

It is possible to set the recording time you wish to view, from 1 to 300 seconds.
The sampling interval is 10 ms.
During data acquisition, the other HMI functions are not available.

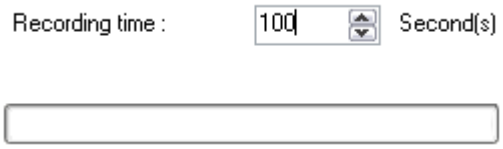


Figure 209

"Curve Drawing" button: used to start data acquisition. Curves are only displayed once acquisition is complete.

"Export Data" button: used to retrieve data corresponding to the selected parameters in a text file (*.txt*). To make this file compatible with the Excel spreadsheet, change its extension to .csv.

Figure 210

Example:

- Position 1: 2,000,000 points, acceleration ramp 400 rpm/sec, speed step 1000 rpm, deceleration ramp 100 rpm/sec.
- Position 2: 0 points, acceleration ramp 400 rpm/sec, speed step 1000 rpm, deceleration ramp 100 rpm/sec. This gives us the following graphic representation:

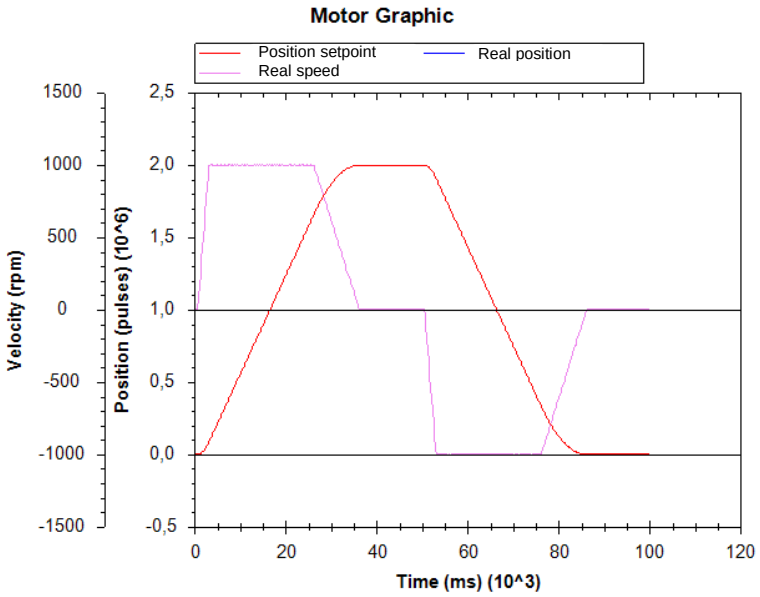


Figure 211

Note: The display scales can be changed with the mouse wheel. Other functions are available by right-clicking the mouse.

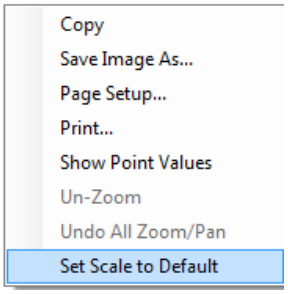


Figure 212

12.2.5.10. "*Limits*" Tab Parameters

WARNING

UNEXPECTED MOVEMENT
An inappropriate setting for the torque values can result in unexpected movements of the application and destruction of the motor.
• Make sure this will not cause any damage.
• Do not continue with the test if there is anyone or any obstacle in the hazardous zone.
Failure to comply with these precautions will result in death, serious injury or equipment damage.

This tab can be used to set the limit values for various parameters.

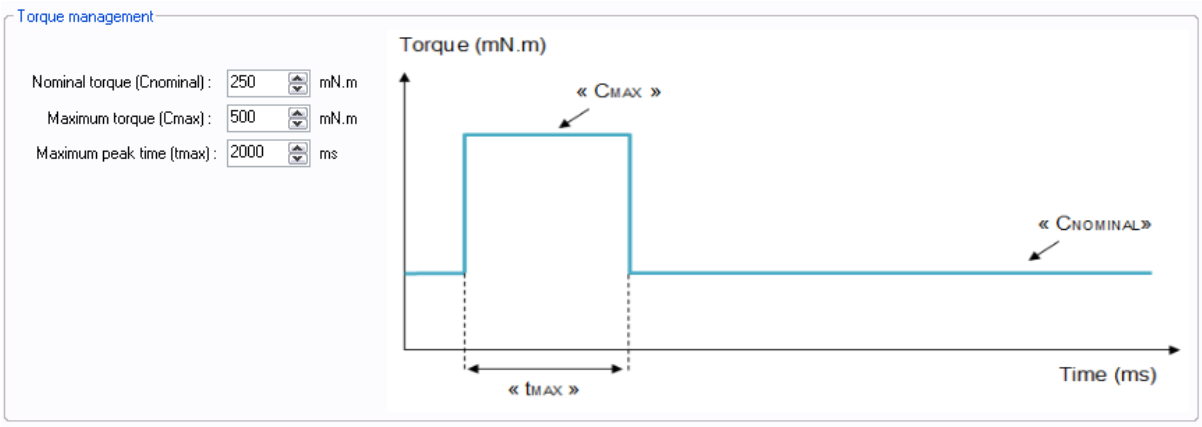


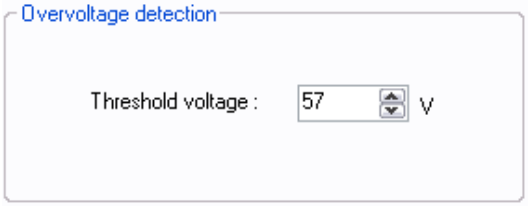
Figure 213

Setting the various torque parameters: When the application torque exceeds the torque "$C_{NOMINAL}$", the motor can provide torque up to the value "C_{MAX}" for the maximum duration " t_{MAX}". Thereafter, if the application torque is still higher than "$C_{NOMINAL}$", the motor torque is limited to the value "$C_{NOMINAL}$" until the application torque falls back below this value.

WARNING

VOLTAGE SURGES
During the braking phases, the motor generates voltage surges.
• Check that its voltage surges can be tolerated by the other devices connected to the same power supply.
• Use an external circuit to limit voltage surges if the brake is being used intensively.
Failure to comply with these precautions will result in death, serious injury or equipment damage.

Setting the overvoltage detection threshold parameters: If the voltage at the motor terminals exceeds this threshold, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).



12.2.5.11. "*Errors*" Tab Parameters

Setting the parameters for the action to be taken when an overtorque error is encountered: real torque higher than the nominal torque "$C_{NOMINAL}$" for a time longer than "t_{MAX}".

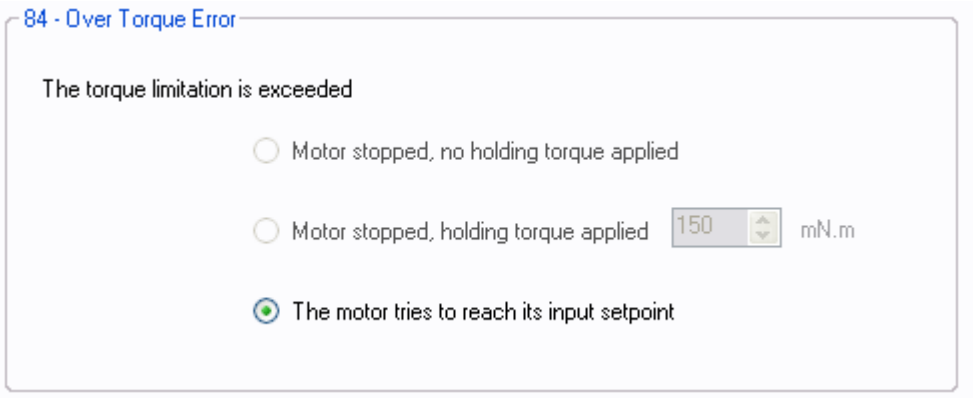


Figure 214

For all errors affecting motor safety, the action to be taken cannot be configured: in the event of an error, the motor stops, and no holding torque is applied (freewheeling).

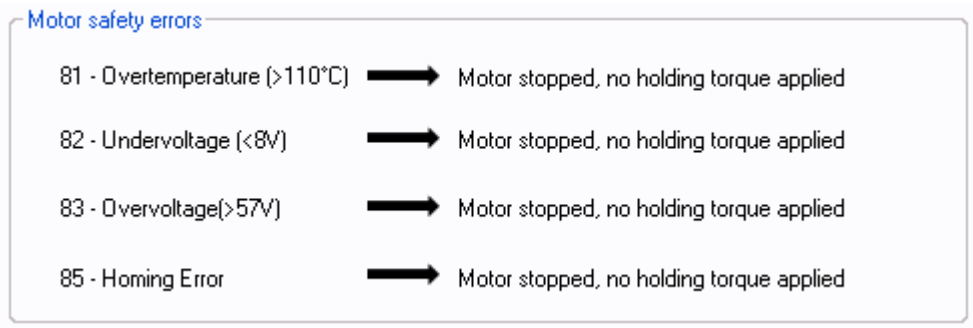


Figure 215

Procedure for restarting the motor following detection of an error:

- Eliminate the cause of the fault.
- Switch to stop mode: disable digital input 6 "On/Off".
- Switch back to run mode: enable digital input 6 "On/Off".

12.2.6. Expert Program P111

12.2.6.1. Description

Expert program P111 is used to:

- Perform a homing phase to initialize the system with detection of the limit switches (switch or mechanical type). A single switch type contact is managed in this program.

- Perform various positionings using 1 to 30 preset setpoint positions, each corresponding to a specific combination of digital inputs "In1" to "In5".

- Set the acceleration/deceleration phases and the maximum speed that must not be exceeded between each point via the HMI.

12.2.6.2. "*Homing*" Tab Parameters

Set the polarity of the switch wired on digital input "In6":

Figure 216

Set the difference in position (in pulses) between the mechanical stops and the application total stroke limits: stop 1 (END1) represents the stroke start, stop 2 (END2) represents the stroke end.

Note: Where there is only one mechanical stop, the "Offset 2" parameter is not available.

Figure 217

Set the search speed for stops during the homing phase.

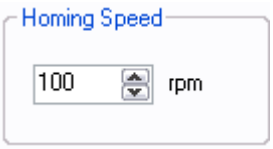


Figure 218

Set the homing torque that allows the mechanical stop to be found by detection of overtorque.

Figure 219

Set the maximum permitted time for the homing phase. If this value is exceeded, an error will be generated. Time limited to 300 s.

Figure 220

Set the direction of rotation for the first stop search.

N.B.: By default, the motor runs forward (CW).

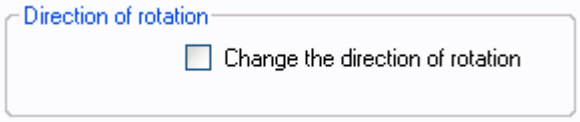


Figure 221

12.2.6.3. "*Inputs*" Tab Parameters

Information concerning the polarity of the switch wired on digital input 6. This polarity is selected in the "Homing" tab (see above).

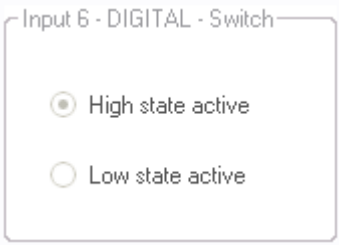


Figure 222

Select the number of position setpoints to be preset (see table below).

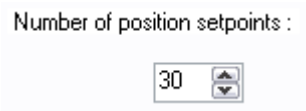


Figure 223

Position Index	IN1	IN2	IN3	IN4	IN5	Position (pulses)	Speed (rpm)	Acceleration (rpm/s)	Deceleration (rpm/s)
Stop	0	0	0	0	0	1	1	1	1
Start Homi...	1	0	0	0	0	1	1000	40000	40000
Position 1	0	1	0	0	0	1000	1000	40000	40000
Position 2	1	1	0	0	0	2000	1000	40000	40000
Position 3	0	0	1	0	0	3000	1000	40000	40000
Position 4	1	0	1	0	0	4000	1000	40000	40000
Position 5	0	1	1	0	0	5000	1000	40000	40000
Position 6	1	1	1	0	0	6000	1000	40000	40000
Position 7	0	0	0	1	0	7000	1000	40000	40000
Position 8	1	0	0	1	0	8000	1000	40000	40000
Position 9	0	1	0	1	0	9000	1000	40000	40000
Position 10	1	1	0	1	0	10000	1000	40000	40000
Position 11	0	0	1	1	0	11000	1000	40000	40000
Position 12	1	0	1	1	0	12000	1000	40000	40000
Position 13	0	1	1	1	0	13000	1000	40000	40000
Position 14	1	1	1	1	0	14000	1000	40000	40000
Position 15	0	0	0	0	1	15000	1000	40000	40000
Position 16	1	0	0	0	1	16000	1000	40000	40000
Position 17	0	1	0	0	1	17000	1000	40000	40000

Figure 224

12.2.6.4. Type 5 "*Outputs*" Tab Parameters

State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.

Figure 225

State of digital output 2 "Homing Sequence Information": Used to find out how the homing phase is progressing: completed, in progress or not performed.

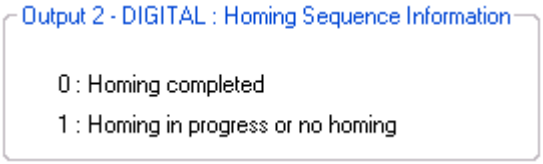


Figure 226

State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

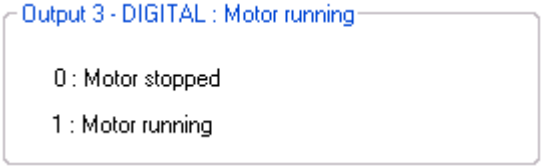


Figure 227

State of digital output 4 "Error": Used to find out whether an error has been detected.

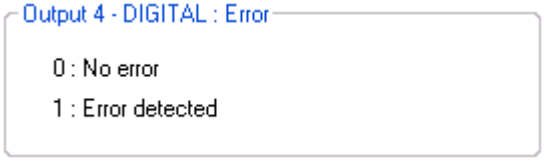


Figure 228

12.2.6.5. Type 6 "*Outputs*" Tab Parameters

State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.

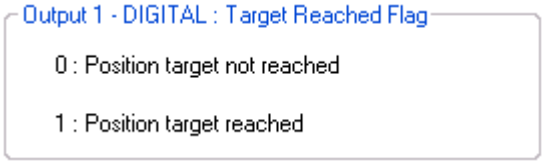


Figure 229

State of digital output 2 "Homing Sequence Information": Used to find out how the homing phase is progressing: completed, in progress or not performed.

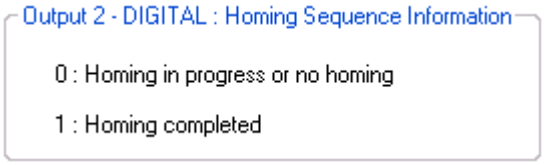


Figure 230

State of digital output 3 "Motor running": Used to find out whether the motor is stopped or running.

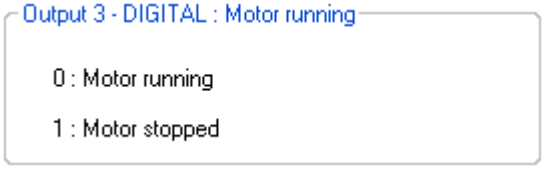


Figure 231

State of digital output 4 "Error": Used to find out whether an error has been detected.

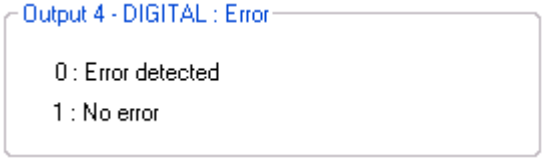


Figure 232

12.2.6.6. Type 7 "*Outputs*" Tab Parameters

State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.

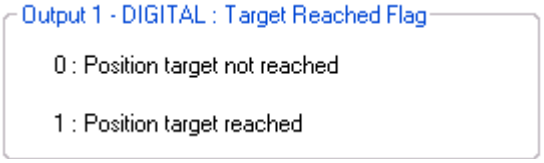


Figure 233

Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".
If cyclical ratio = 50% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

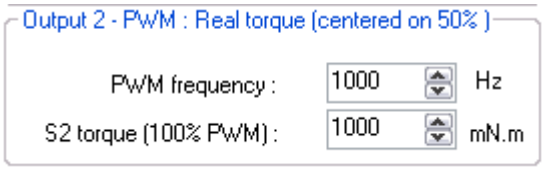


Figure 234

Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

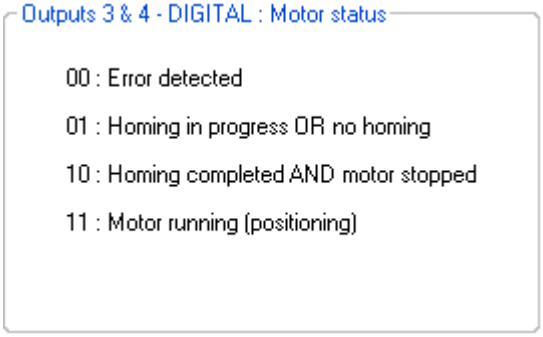

Outputs 3 & 4 - DIGITAL : Motor status
00 : Error detected
01 : Homing in progress OR no homing
10 : Homing completed AND motor stopped
11 : Motor running (positioning)

Figure 235

12.2.6.7. Type 8 "*Outputs*" Tab Parameters

State of digital output 1 "Target Reached Flag": Used to find out whether the position setpoint has been reached.

Figure 236

Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".
If cyclical ratio = 50% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

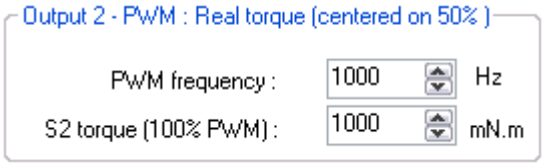


Figure 237

Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

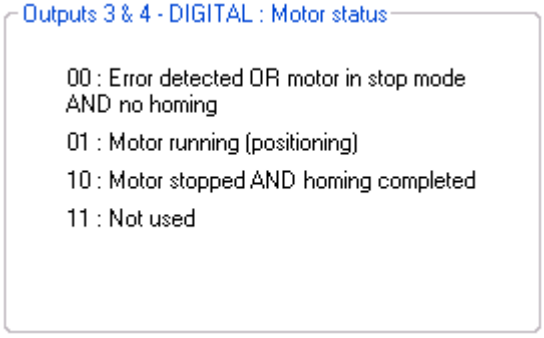

Outputs 3 & 4 - DIGITAL : Motor status
00 : Error detected OR motor in stop mode AND no homing
01 : Motor running (positioning)
10 : Motor stopped AND homing completed
11 : Not used

Figure 238

12.2.6.8. Type 9 "*Outputs*" Tab Parameters

Setting the parameters of Pulse output 1 "Real speed": A Hall pulse with configurable width (100 to 800 µs) is generated each time one of the 3 motor Hall sensors changes state.

80140_SMI21 and 80180_SMI21 motors have 12 Hall pulses per revolution (2 pairs of poles).
The 80280_SMI21 motor has 24 Hall pulses per revolution (4 pairs of poles).

Figure 239

State of digital output 2 "Real direction": Used to find out the motor direction of rotation.

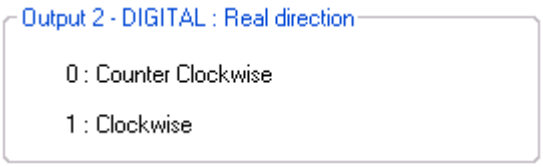


Figure 240

Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

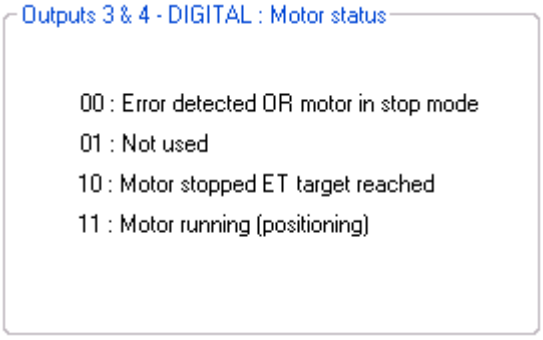

Outputs 3 & 4 - DIGITAL : Motor status
00 : Error detected OR motor in stop mode
01 : Not used
10 : Motor stopped ET target reached
11 : Motor running (positioning)

Figure 241

12.2.6.9. "*Tuning*" Tab Parameters

Selection of the various parameters to be represented in graphic form: either 1, 2, 3 or 4 parameters. The system position response (measurement vs setpoint) can therefore be compared while displaying changes in the current and the speed.

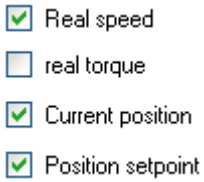


Figure 242

Set the PID controller factors in the position control loop (this function is reserved for advanced users). The values given in the example below ensure correct product operation in the majority of cases.

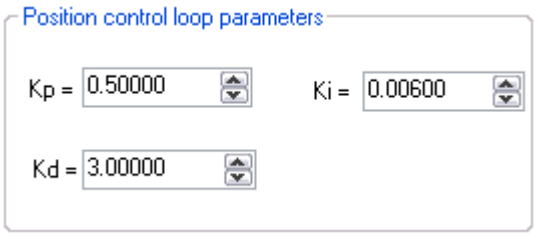


Figure 243

It is possible to set the recording time you wish to view, from 1 to 300 seconds.
The sampling interval is 10 ms.
During data acquisition, the other HMI functions are not available.

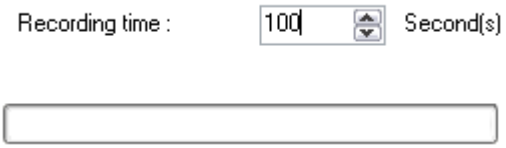


Figure 244

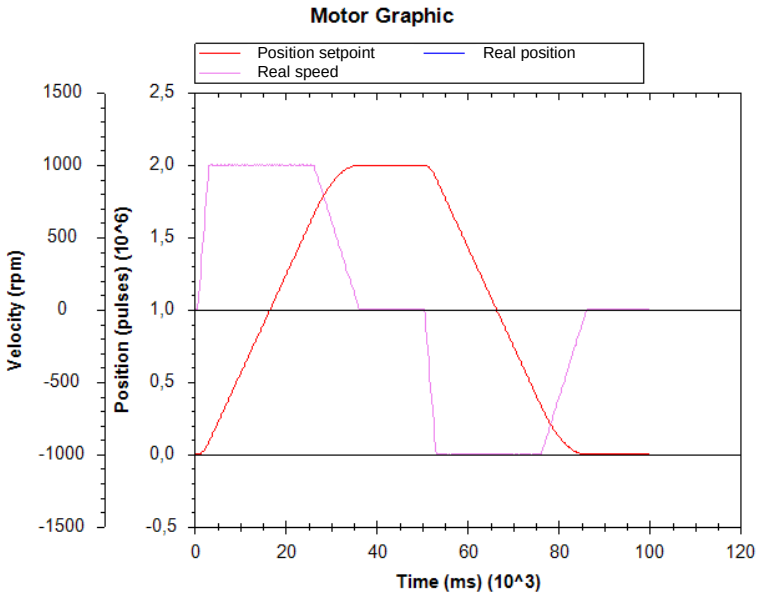
"Curve Drawing" button: used to start data acquisition. Curves are only displayed once acquisition is complete.

"Export Data" button: used to retrieve data corresponding to the selected parameters in a text file (*.txt*). To make this file compatible with the Excel spreadsheet, change its extension to .csv.

Figure 245

Example:

- Position 1: 2,000,000 points, acceleration ramp 400 rpm/sec, speed step 1000 rpm, deceleration ramp 100 rpm/sec.
- Position 2: 0 points, acceleration ramp 400 rpm/sec, speed step 1000 rpm, deceleration ramp 100 rpm/sec. This gives us the following graphic representation:



Note: The display scales can be changed with the mouse wheel. Other functions are available by right-clicking the mouse.

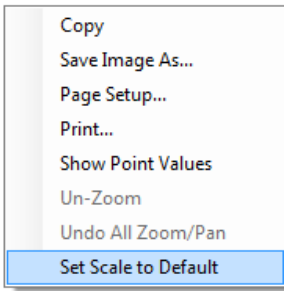


Figure 246

12.2.6.10. "*Limits*" Tab Parameters

WARNING

UNEXPECTED MOVEMENT
An inappropriate setting for the torque values can result in unexpected movements of the application and destruction of the motor.
• Make sure this will not cause any damage.
• Do not continue with the test if there is anyone or any obstacle in the hazardous zone.
Failure to comply with these precautions will result in death, serious injury or equipment damage.

This tab can be used to set the limit values for various parameters.

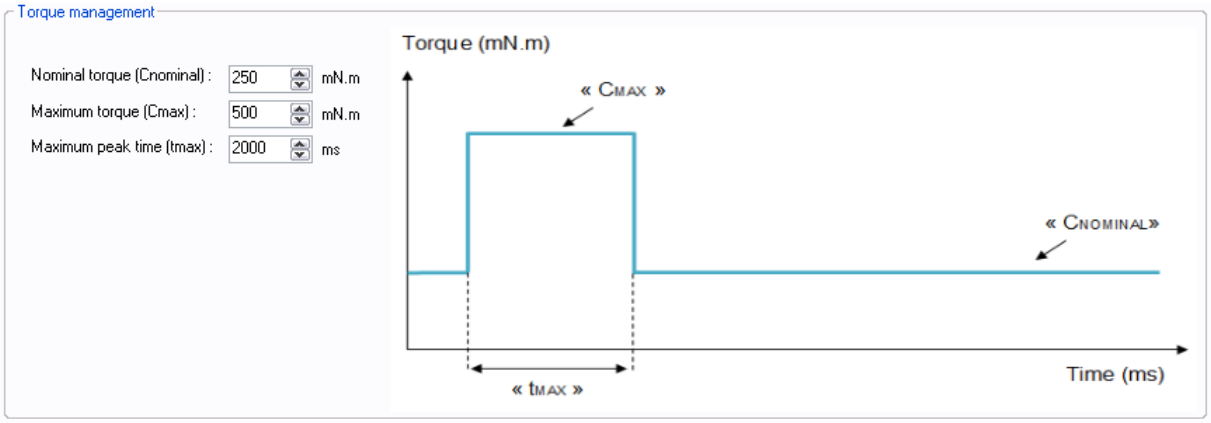


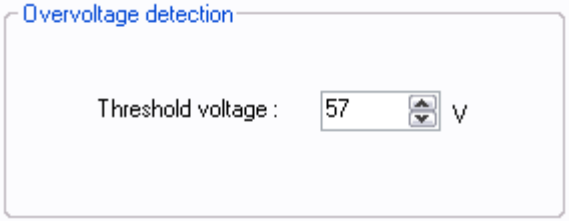
Figure 247

Setting the various torque parameters: When the application torque exceeds the torque "$C_{NOMINAL}$", the motor can provide torque up to the value "C_{MAX}" for the maximum duration "t_{MAX}". Thereafter, if the application torque is still higher than "$C_{NOMINAL}$", the motor torque is limited to the value "$C_{NOMINAL}$" until the application torque falls back below this value.

WARNING

VOLTAGE SURGES
During the braking phases, the motor generates voltage surges.
• Check that its voltage surges can be tolerated by the other devices connected to the same power supply.
• Use an external circuit to limit voltage surges if the brake is being used intensively.
Failure to comply with these precautions will result in death, serious injury or equipment damage.

Setting the overvoltage detection threshold parameters: If the voltage at the motor terminals exceeds this threshold, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).



12.2.6.11. "*Errors*" Tab Parameters

Setting the parameters for the action to be taken when an overtorque error is encountered: real torque higher than the nominal torque "$C_{NOMINAL}$" for a time longer than "t_{MAX}".

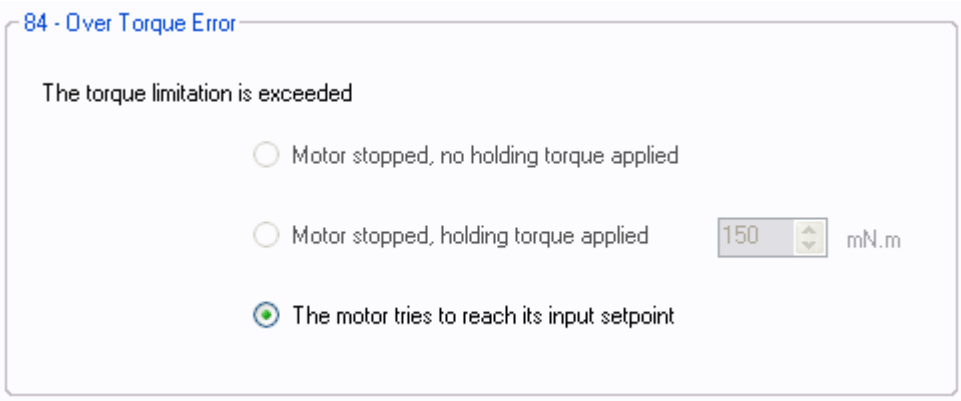


Figure 248

For all errors affecting motor safety, the action to be taken cannot be configured: in the event of an error, the motor is stopped and no holding torque is applied (freewheeling).

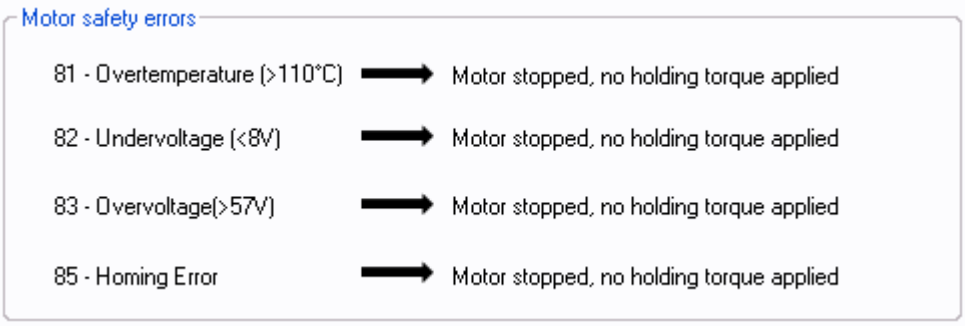


Figure 249

Procedure for restarting the motor following detection of an error:

- Eliminate the cause of the fault.
- Switch to stop mode: disable digital inputs 1 to 5.
- Switch back to run mode: enable one of digital inputs 1 to 5.

12.3. Torque Programs

12.3.1. Types of Inputs in C100 Programs

The table below defines the function associated with each of the inputs in the 2 C100 programs (the color associated with the input number corresponds to that of the I/O bundle):

	Programs	
Inputs	**C101**	**C102**
In1	ON/OFF	000 : "In6" torque setpoint 001 : Priority torque 1 010 : Priority torque 2 100 : Priority torque 3
In2	Direction	
In3	Not used	
In4	Fast stop	00 : Fast stop 10 : CCW 01 : CW 11 : Stop, disable error
In5	Torque ramp	
In6	Torque	Torque (if In1 = In2 = In3 = 0)

Key:

- Digital type input
- Analog or PWM type input
- Forthcoming programs

12.3.2. Types of Outputs in C100 Programs

For all expert torque programs, we have 2 configurable output configurations (the color associated with the output number corresponds to that of the I/O bundle):

	Out1	**Out2**	**Out3**	**Out4**
Type 2	Real speed	Real torque	Motor running	Error
	PWM	*PWM*	*Digital*	*Digital*
Type 10	Real speed (centered on 50%)	Real torque (centered on 50%)	00 : error detected 01 : motor running 10 : motor stopped, torque position reached and held 11 : motor stopped, no torque applied	
	PWM	*PWM*	*Digital combinations*	

Key:

- Digital type output
- PWM/Pulse/Frequency type output

12.3.3. Description of the Various Tabs

For the description of tabs, expert program C101 is used as an example (for detailed information about each torque expert program, see the "Expert Program C101" section in this document).

12.3.3.1. Home Page

This page is common to all the expert and application programs, whether in speed, position or torque mode. It can be used to choose between the various types of application and expert programs.

In our example, we have chosen the "Torque C100" category in the "Expert Programs" group, so the icons for the various C100 expert programs appear in the bottom right-hand corner of the window, and you then need to click on the one corresponding to the "C101" expert program:

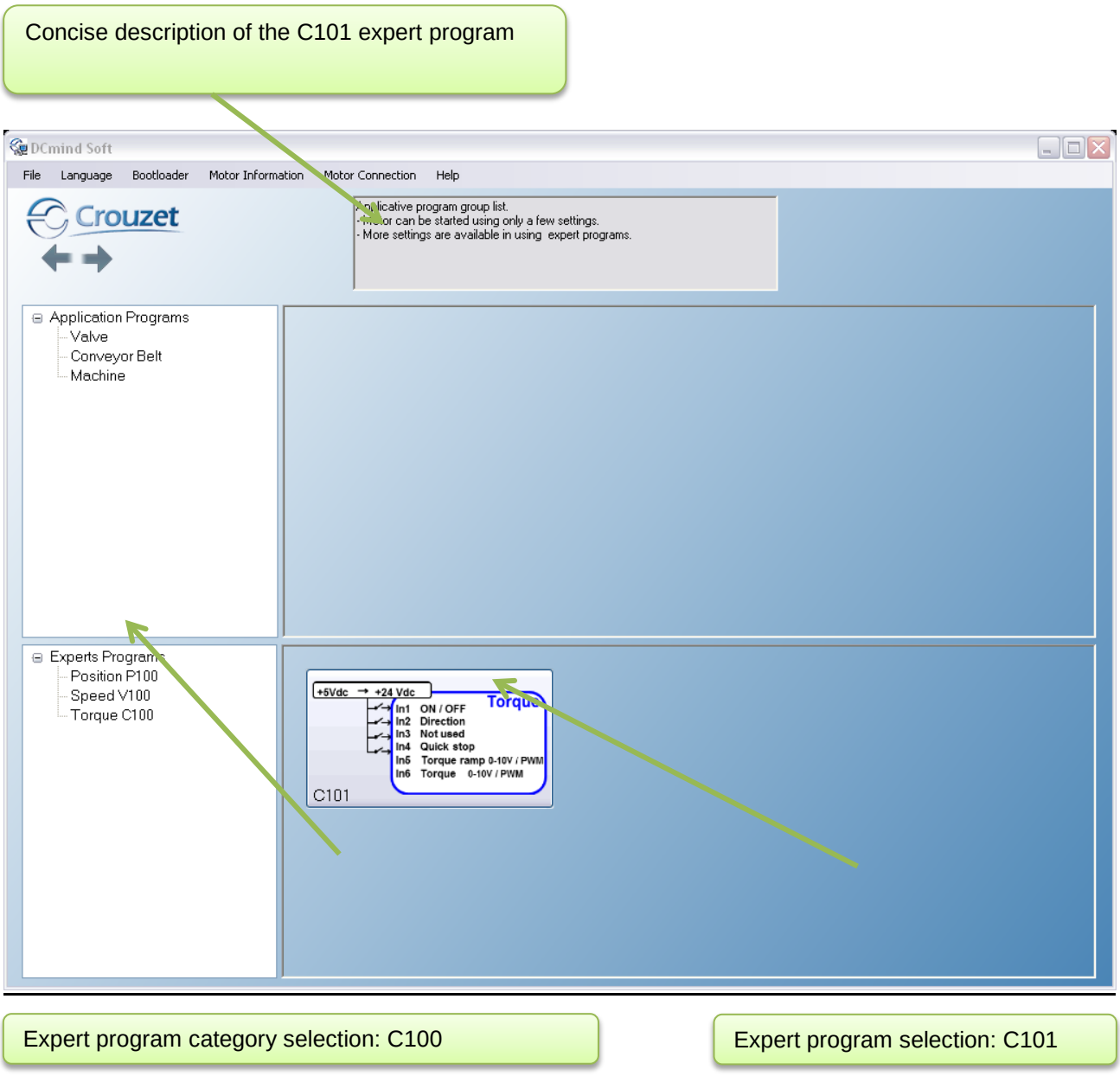


Figure 250

12.3.3.2. "Description" Tab

This is an information tab containing a concise description of the various torque profiles that are created using this expert mode:

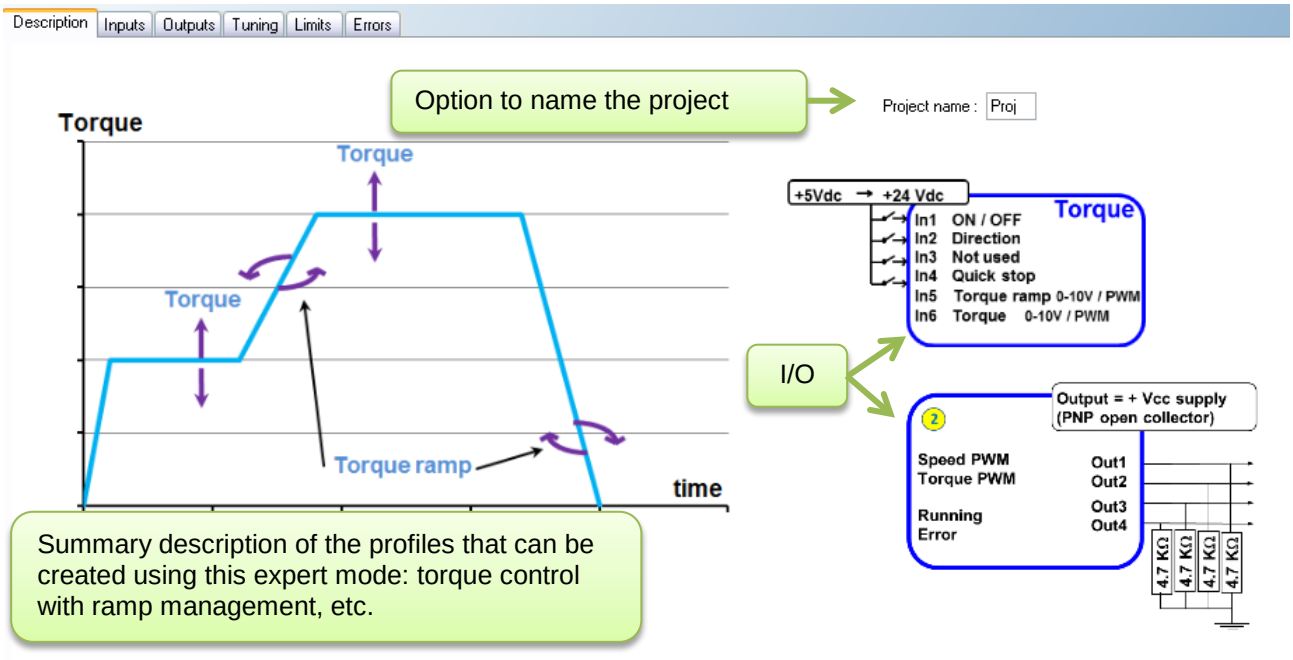


Figure 251

12.3.3.3. "Inputs" Tab

This tab is used to configure the various inputs in this expert mode (digital input polarity, value, control type, maximum and minimum control limit, etc.):

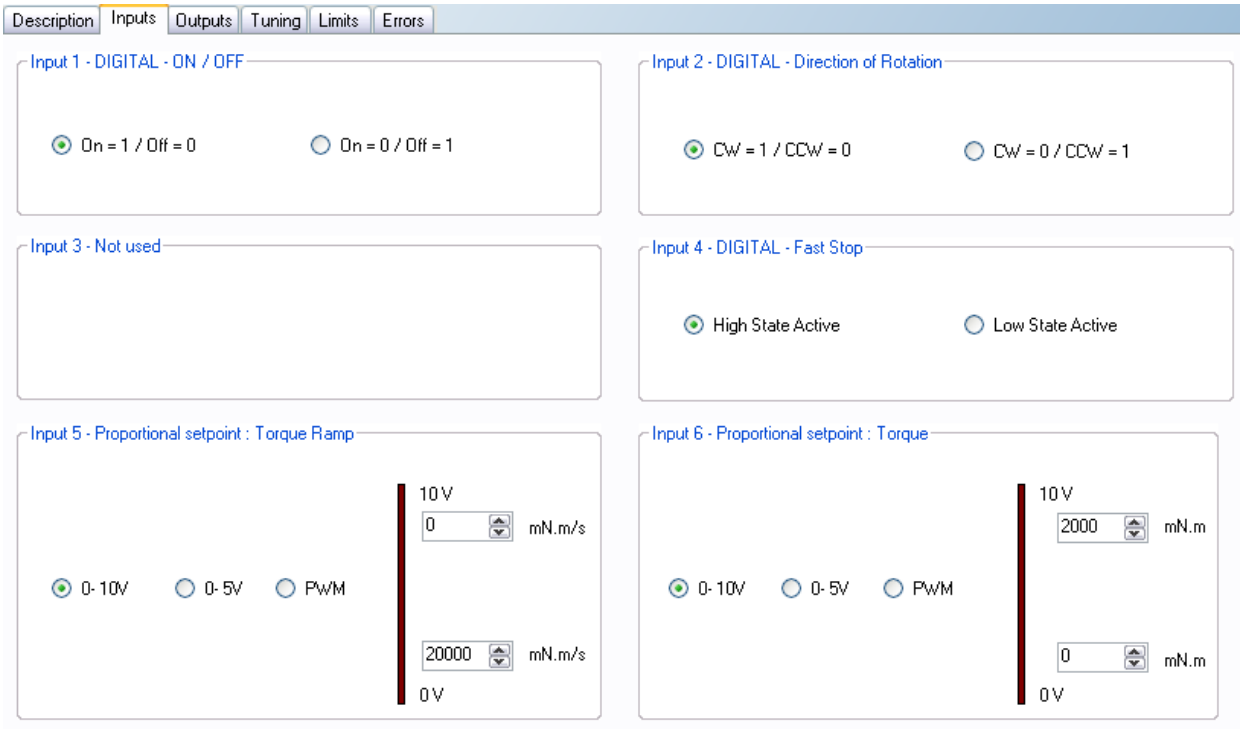


Figure 252

12.3.3.4. "Outputs" Tab

This tab is used to select and configure the various outputs in this expert mode (torque type 2 and type 10):

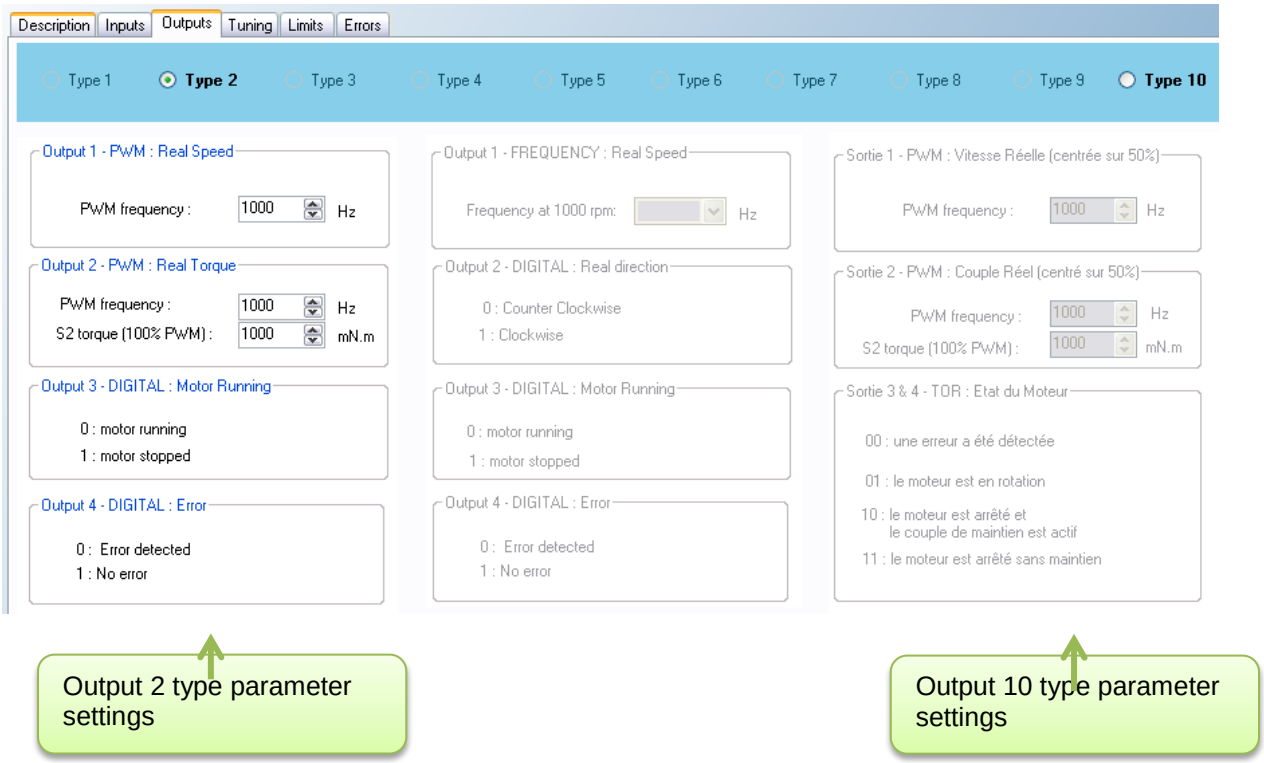


Figure 253

12.3.3.5. "Tuning" Tab

This tab is used to represent some parameters (speed, torque, etc.) in graphic form and modify the torque control loop coefficients. It is common to all the torque expert programs.

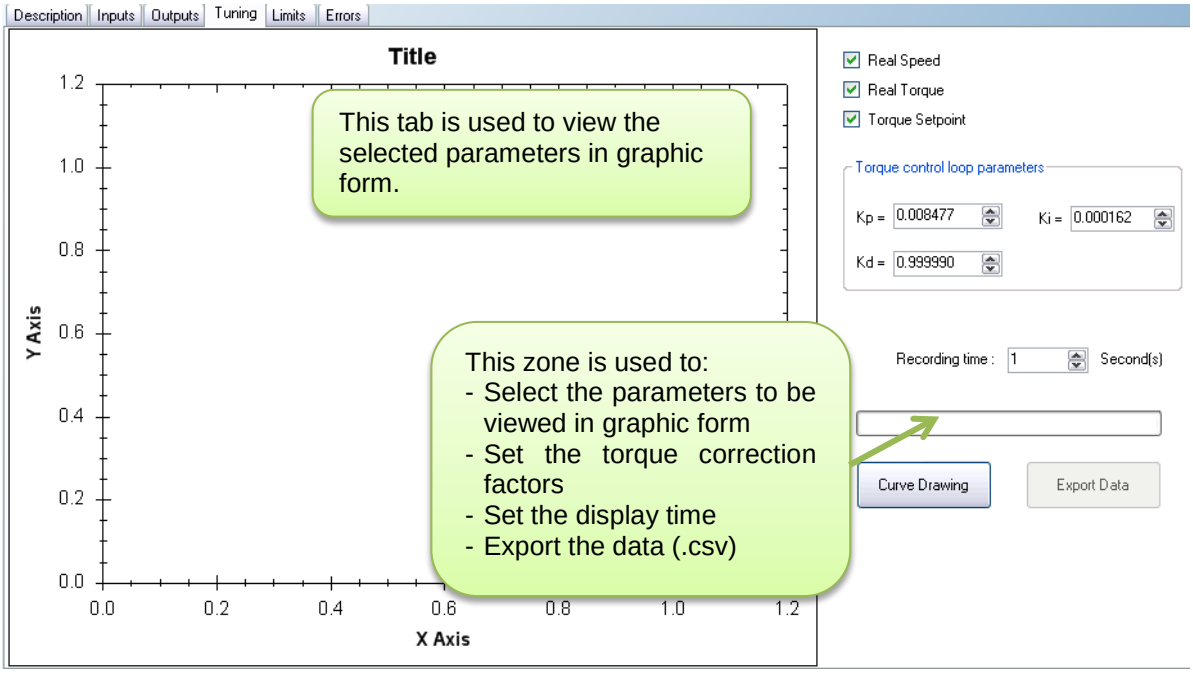


Figure 254

12.3.3.6. "Limits" Tab

This tab can be used to set the power supply overvoltage threshold.

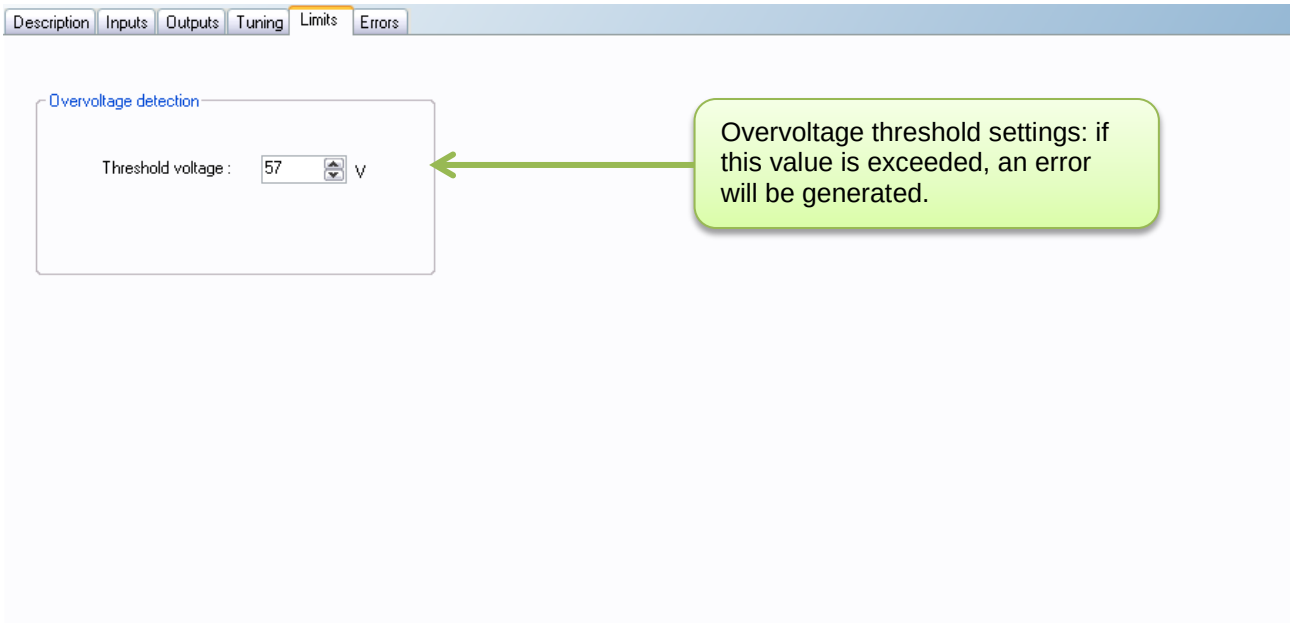


Figure 255

12.3.3.7. "Errors" Tab

This tab provides information about the type of error encountered (based on the error code) and the action to be taken by the motor following this error.

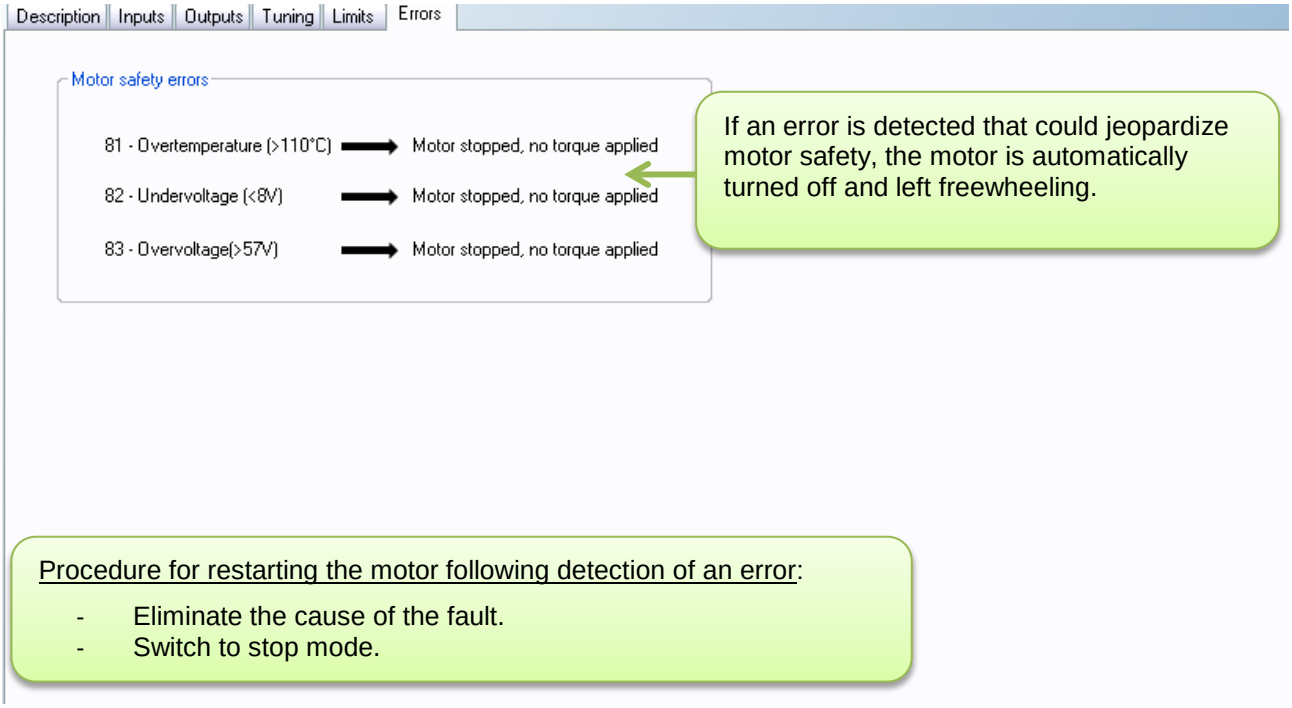


Figure 256

12.3.4. Expert Program C101

12.3.4.1. Description

Expert program C101 is used to:

- Create torque profiles with analog or PWM control.
- Set the torque up and down ramps with analog or PWM control.

12.3.4.2. "*Inputs*" Tab Parameters

Digital input 1: Used to set the "On/Off" input polarity.

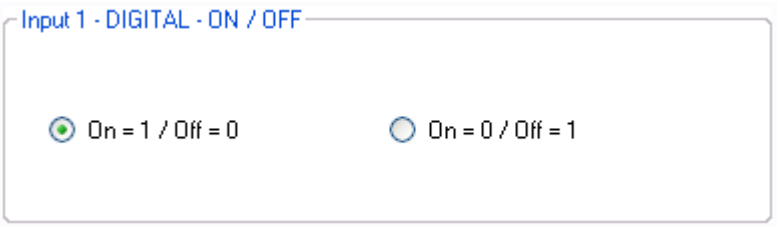


Figure 257

Digital input 2: Used to set the "Direction of Rotation" input polarity.

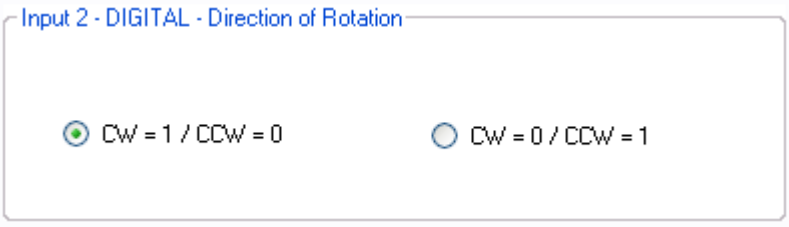


Figure 258

Digital input 3: Not used

Digital input 4: Used to set the "Fast stop" input polarity.

This input is used to stop the motor as quickly as possible, ignoring the setpoints applied to the other inputs.

Figure 259

Setpoint input 5: Used to select the control type for the torque ramp setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

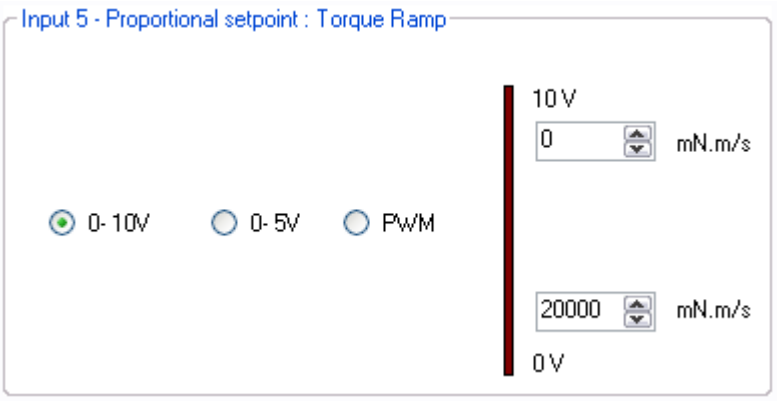


Figure 260

Setpoint input 6: Used to select the control type for the torque setpoint and fix the maximum and minimum limits for this setpoint. An inverted scale can be used.

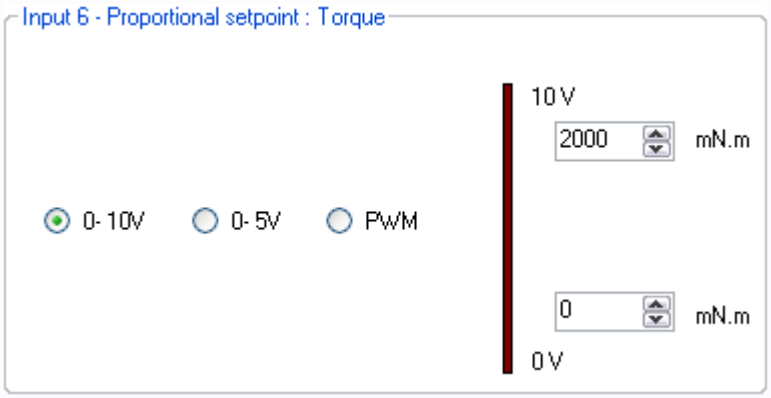


Figure 261

12.3.4.3. Type 2 "*Outputs*" Tab Parameters

Setting the parameters of PWM output 1 "Real Speed": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Real speed = 0 rpm.
If cyclical ratio = 100% → Real speed = maximum speed setpoint defined in In6.

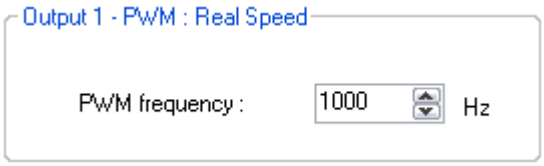


Figure 262

Setting the parameters of PWM output 2 "Real Torque": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Torque supplied = "S2 torque".

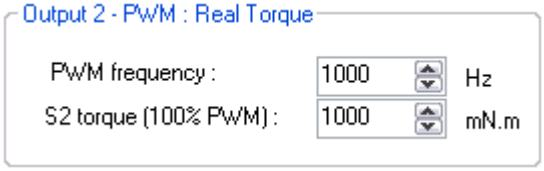


Figure 263

State of digital output 3 "Motor Running": Used to find out whether the motor is stopped or running.

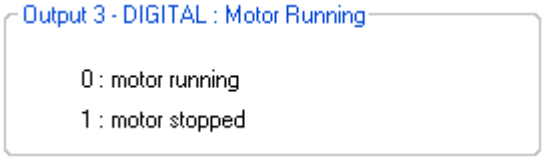


Figure 264

State of digital output 4 "Error": Used to find out whether an error has been detected.

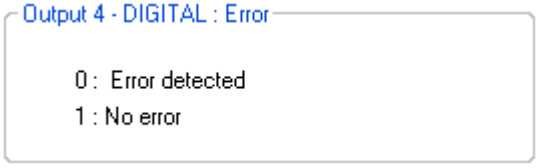


Figure 265

12.3.4.4. Type 10 "*Outputs*" Tab Parameters

Setting the parameters of PWM output 1: "Real speed (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 2).

If cyclical ratio = 0% → Motor running forward (CW) at maximum speed setpoint defined in In6.
If cyclical ratio = 50% → Real speed = 0 rpm.
If cyclical ratio = 100% → Motor running in reverse (CCW) at maximum speed setpoint defined in In6.

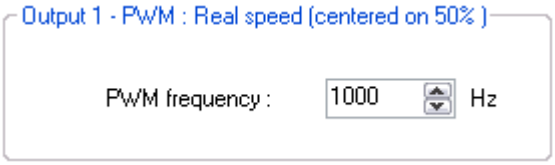


Figure 266

Setting the parameters of PWM output 2 "Real torque (centered on 50%)": The parameters can be set for the signal frequency of this output (must be identical to the one for PWM output 1) and the torque value corresponding to a cyclical ratio of 100% (scaling).

If cyclical ratio = 0% → Braking torque supplied = "S2 torque".
If cyclical ratio = 50% → Torque supplied = 0 mNm.
If cyclical ratio = 100% → Motor torque supplied = "S2 torque".

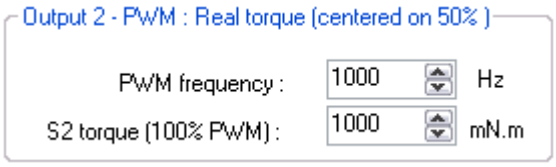


Figure 267

Combinations of digital outputs 3 & 4 "Motor status": Used to find out the motor status.

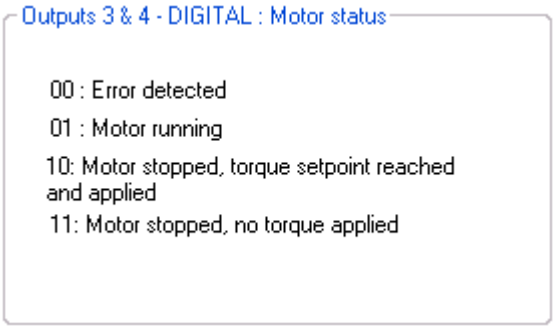

Outputs 3 & 4 - DIGITAL : Motor status
00 : Error detected
01 : Motor running
10: Motor stopped, torque setpoint reached and applied
11: Motor stopped, no torque applied

Figure 268

12.3.4.5. "*Tuning*" Tab Parameters

Selection of the various parameters to be represented in graphic form: either 1, 2 or 3 parameters. The system torque response (measurement vs setpoint) can therefore be compared while displaying changes in the speed.

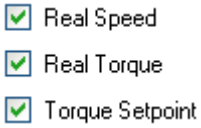


Figure 269

Set the PID controller factors in the torque control loop (this function is reserved for advanced users). The values given in the example below ensure correct product operation in the majority of cases.

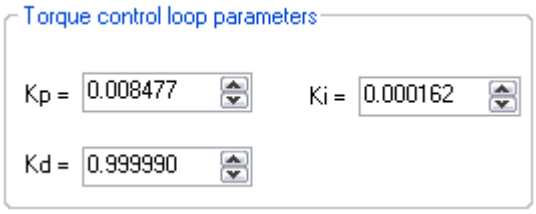


Figure 270

It is possible to set the recording time you wish to view, from 1 to 300 seconds.
The sampling interval is 10 ms.
During data acquisition, the other HMI functions are not available.

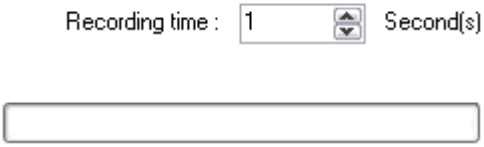


Figure 271

"Curve Drawing" button: used to start data acquisition. Curves are only displayed once acquisition is complete.

"Export Data" button: used to retrieve data corresponding to the selected parameters in a text file (*.txt*). To make this file compatible with the Excel spreadsheet, change its extension to .csv.

Figure 272

Example: With a torque setpoint on input 6 at 200 mN.m and a torque ramp setpoint on input 5 at 50 mN.m/s, this gives us the following graphic representation (recording time of 20 seconds):

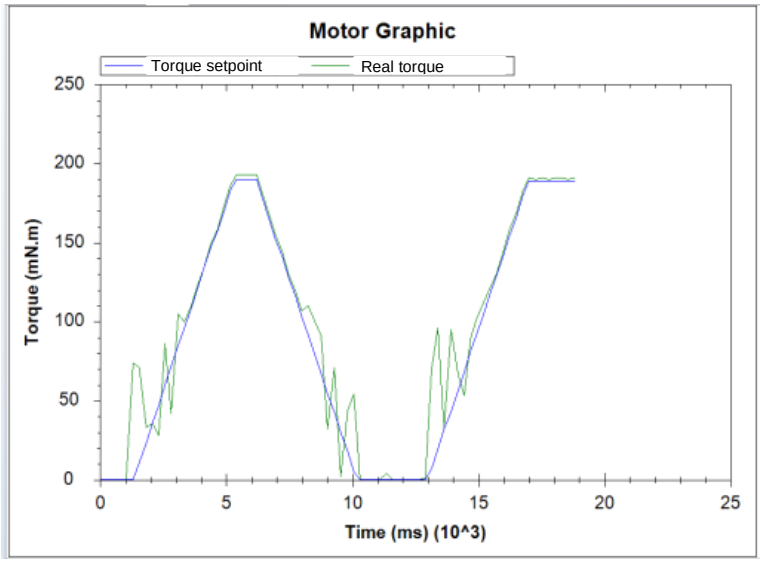


Figure 273

Note: The display scales can be changed with the mouse wheel. Other functions are available by right-clicking the mouse.

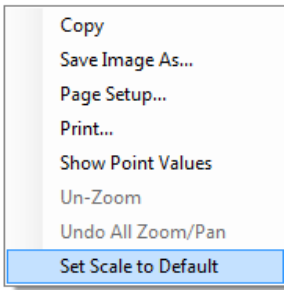


Figure 274

12.3.4.6. "*Limits*" Tab Parameters

WARNING
VOLTAGE SURGES During the braking phases, the motor generates voltage surges. • Check that its voltage surges can be tolerated by the other devices connected to the same power supply. • Use an external circuit to limit voltage surges if the brake is being used intensively. **Failure to comply with these precautions will result in death, serious injury or equipment damage.**

Setting the overvoltage detection threshold parameters: If the voltage at the motor terminals exceeds this threshold, an error is generated, the motor is stopped and no holding torque is applied (freewheeling).

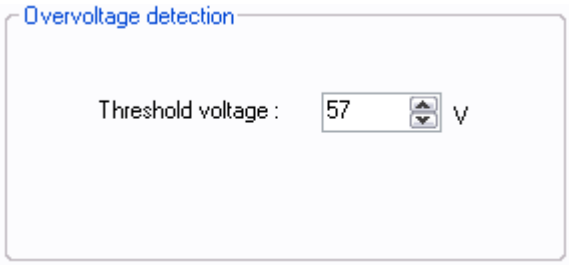


Figure 275

12.3.4.7. "*Errors*" Tab Parameters

For all errors affecting motor safety, the action to be taken cannot be configured: in the event of an error, the motor is stopped and no holding torque is applied (freewheeling).

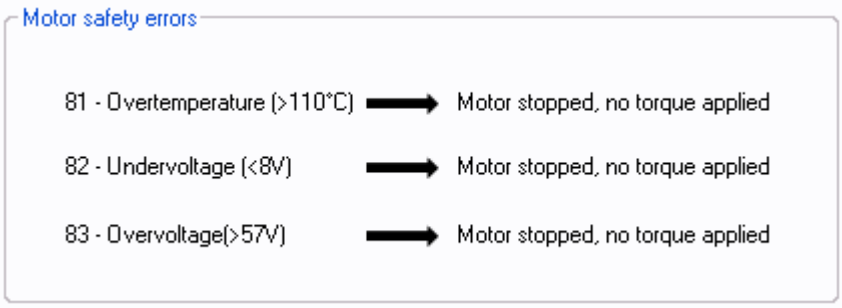


Figure 276

Procedure for restarting the motor following detection of an error:

- Eliminate the cause of the fault.
- Switch to stop mode: disable digital input 1 "On/Off".
- Switch back to run mode: enable digital input 1 "On/Off".

13. SAVING PARAMETERS

In all the expert programs (speed, position and torque), the user can give a name to his project (4 alphanumerical characters maximum) using the "Project name" parameter in the program "Description" tab (expert program V101 will be used as an example):

Figure 277

Once he has configured his application, the user should upload the program to the motor.
This action is essential so that the motor can take account of the project name and the associated parameters.

The "Project name" parameter can be accessed by clicking the "Motor Information" tab in the main menu bar:

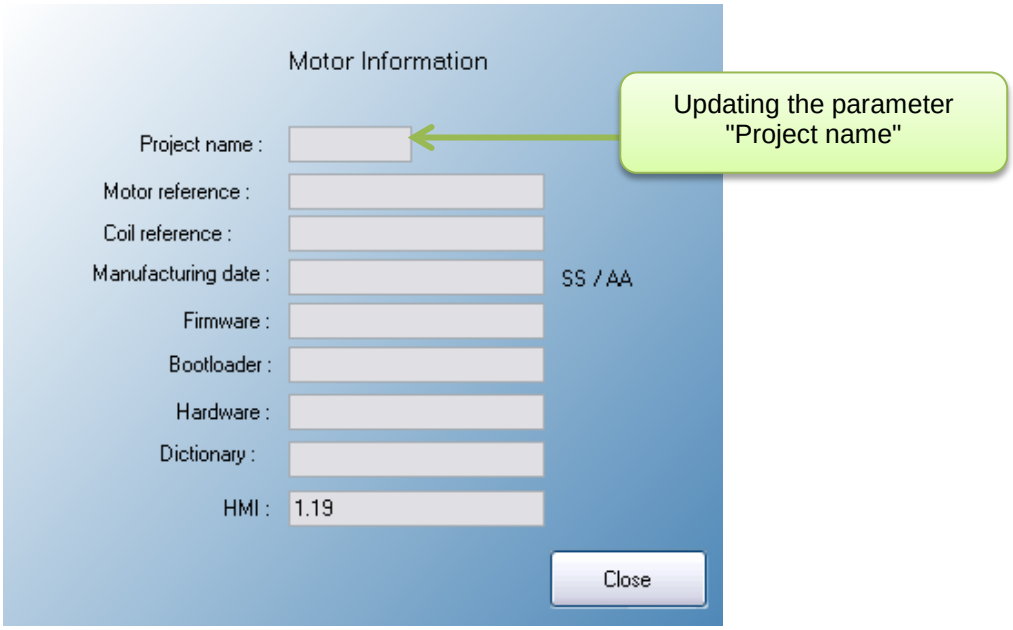


Figure 278

The project parameters can be saved in an .xml file by clicking on "**Save As**" in the "File" tab of the main menu.

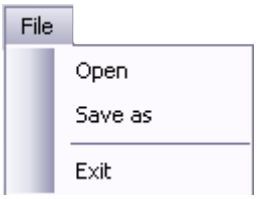


Figure 279

They can also be reused by clicking on "**Open**" in the "File" tab of the main menu, then selecting the appropriate "*MOT1.xml*" file.

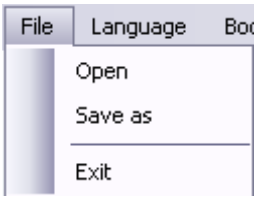


Figure 280

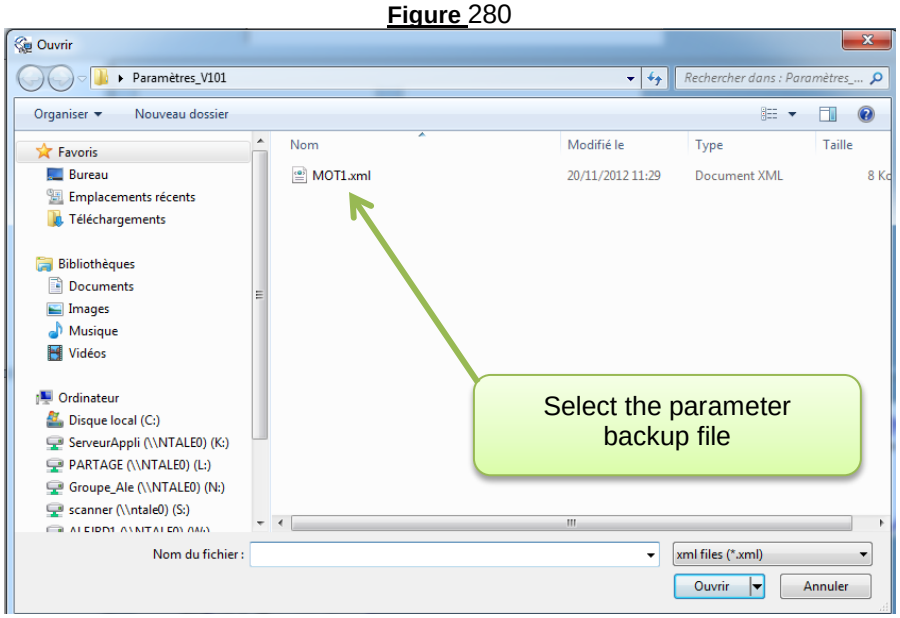


Figure 281

When the parameter file is uploaded, the HMI automatically launches the associated expert or application program (in our example expert program V101):

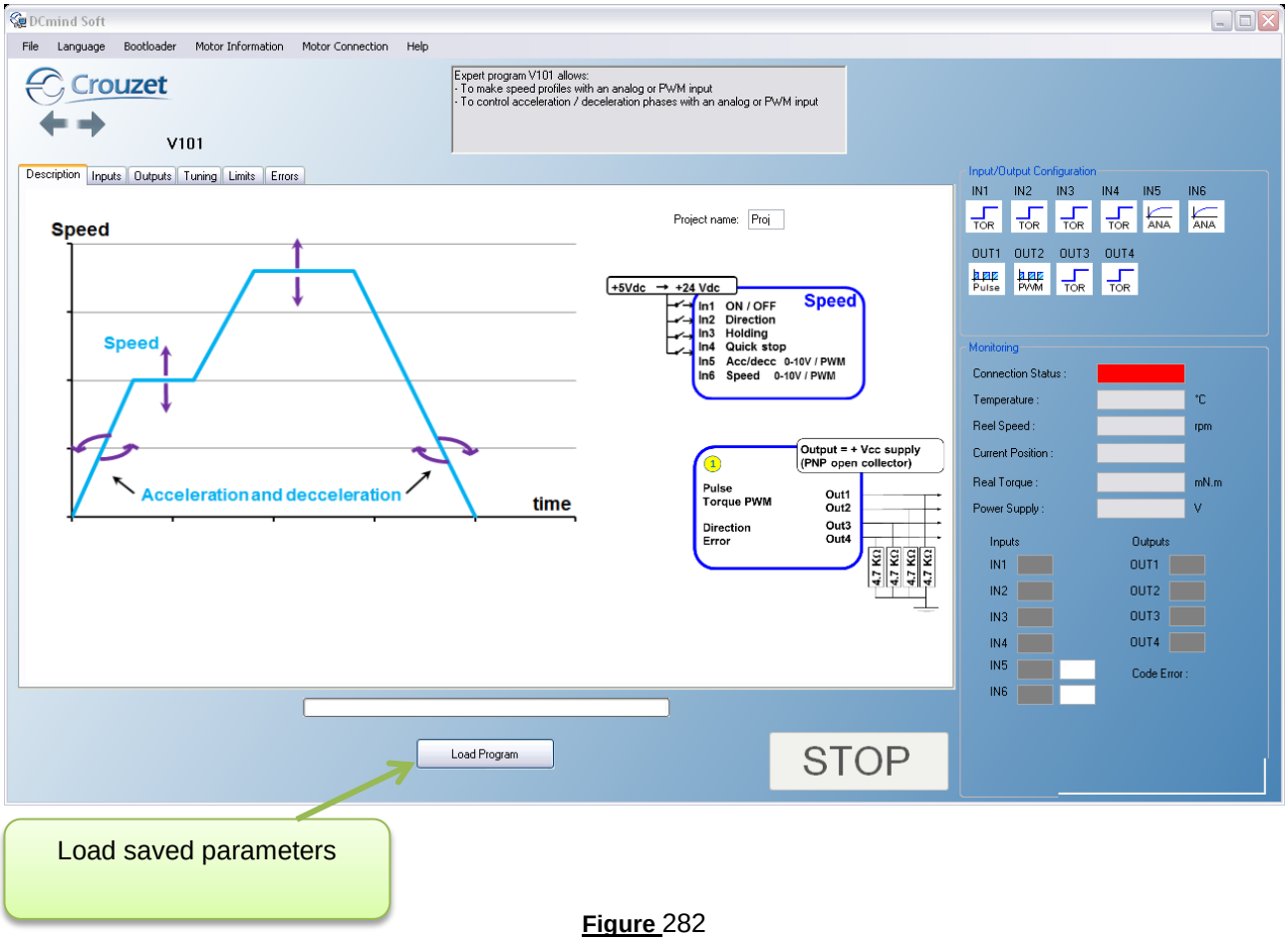


Figure 282

Press the "Load Program" button to load the "MOT1.xml" file parameters in the motor.

14. DIAGNOSTICS AND TROUBLESHOOTING

14.1. Mechanical Failures

Error	Cause	Remedy
Significant temperature rise	Overload Holding brake not released	Reduce the load Check control of the holding brake
Whistling or knocking	Faulty bearings	Contact the after-sales service
Friction noise	A rotary transmission device is catching	Align the transmission device
Radial vibration	Transmission device incorrectly aligned Transmission device unbalanced Twisted shaft Resonance in the fixing	Align the transmission device Balance the transmission device Contact the after-sales service Check the rigidity of the motor fixing
Axial vibration	Transmission device incorrectly aligned Transmission device being knocked Resonance in the fixing	Align the transmission device Check the transmission device Check the rigidity of the motor fixing

14.2. Electrical Failures

Error	Cause	Remedy
The motor does not start or starts with difficulty	Overload Fault in the connection wires	Reduce the load Check the connection wires Contact the after-sales service
Significant temperature rise in the stator	Overload	Reduce the load
Temperature rise in the connection terminals	Power supply wires disconnected or loose	Tighten the screws

15. SERVICE, MAINTENANCE AND DISPOSAL

15.1. Addresses of After-Sales Service Outlets

Please contact your distributor.
The list of distributors is accessible on the CROUZET Automatismes website **www.crouzet.com**

15.2. Storage

The motors must only be transported and stored in dry, dust-free environments that are resistant to vibration.
The ambient conditions are stated in the product technical data sheet and must be adhered to.
The storage period is essentially dictated by the stability of the lubricants and should be less than 36 months.
To keep the motor in working order, it is advisable to start up the drive solution occasionally.

15.3. Maintenance

Only the manufacturer is authorized to undertake repairs. Any personal intervention voids any guarantee and precludes manufacturer liability.
Repairs cannot be performed with the motor mounted.

Prior to any intervention on the drive system, please refer to the *Installation and Commissioning* sections to find out what steps to take.

We recommend that the following operations are done at regular intervals.
Connections and fixing
=> Check the connection cables and connections regularly for signs of damage. Replace any damaged cables immediately.
=> Check that all the transmission devices are fully tightened.
=> Retighten all the mechanical and electrical bolted connections to the appropriate tightening torque.

⚠ WARNING

UNEXPECTED MOVEMENT
Exceeding the permissible ambient conditions can allow foreign bodies from the surrounding area to get in and lead to unexpected motor movements or damage to equipment.
• Check the ambient conditions.
• It is vital to avoid fluid stagnation in the shaft bushing.
Failure to comply with these precautions can result in death, serious injury or damage to equipment.

Cleaning
Clean the motor regularly to remove any dust and dirt. If heat cannot dissipate adequately into the ambient air, this can cause abnormally high temperatures.
The motors are not designed to be cleaned with high-pressure washers. Jet washing can cause water to get inside the motor.
When using cleaning products or solvents, take care not to damage the motor power supply leads and any options (brake), ball bearings and the motor coating.

Check/run in the holding brake
Occasional braking with a shifted load helps conserve the holding brake's holding torque. If the holding brake produces no mechanical work over a prolonged period (braking with a shifted load), some parts of the holding brake can corrode or other deposits can accumulate and thus reduce the holding torque.

The holding brake has been run in on leaving the factory. If the holding brake produces no mechanical work over a prolonged period, some parts of the holding brake can corrode. If the holding brake should not demonstrate the holding torque specified in the technical specifications, it would need to be run in again:
=> The motor is not mounted. The holding brake is engaged.

=> Measure the brake holding torque using a torque wrench.
=> Compare the value with the holding torque indicated on the technical data sheet.
=> If the holding torque is markedly different from the stated values, turn the motor shaft by hand 25 turns in both directions.
=> Repeat the operation. If the holding torque has not been restored after 3 repeat operations, please contact your vendor.

15.4. Replacing the Motor

=> Disconnect all the supply voltages. Make sure that no other voltage is applied (safety instructions).
=> Mark all connections and demount the product.
=> Replace it with a motor with the same part number.
=> Install the new product as described in section 4 "Installation".
=> Commission the product as described in section 5 "Commissioning".

15.5. Dispatch, Storage, Disposal

Comply with the ambient conditions described in the "TECHNICAL SPECIFICATIONS" section.

Dispatch
Protect the product against shocks during transport.
Use the original packaging for this purpose.

Storage
Only store the product in the stated permissible ambient conditions in terms of temperature and air humidity.
Protect the product against dust and dirt.

Disposal
The product is made up of various materials that can be reused or are suitable for separation and recycling.
Dispose of the product in accordance with local regulations.

15.6. Terminology and Abbreviations

Encoder
Mounted on the motor, the angular position sensor provides frequency pulses proportional to the motor speed.

Degree of protection
The degree of protection is a standard definition used for electrical equipment that aims to describe the protection against penetration of solids and liquids inside the motor casing (for example IP54M). The M indicates that the tests are conducted with the motor running.
This value cannot take account of the seal around the output shaft, for which the installer must take responsibility.

Axial forces
Longitudinal traction or compression forces affecting the shaft.

Radial forces
Radial forces affecting the shaft.

Direction of rotation
Positive or negative direction of rotation of the motor shaft. The positive direction of rotation is clockwise rotation of the motor shaft, when looking at the motor from the output shaft.

Nominal speed
Motor speed of rotation when nominal torque is applied.

Nominal current
Current drawn by the motor when nominal torque is applied.

Nominal torque
Maximum applicable torque in continuous duty on the motor shaft.

Firmware
Control software embedded in the motor.

Bootloader
Function available in the HMI which can be used to update the firmware.

Commonly used abbreviations:

HMI:	Human-Machine Interface
SMI21:	Trade name of the new CROUZET brushless range
Homing:	Initialization phase for finding the limits
AON:	Type of digital inputs/outputs (All Or Nothing)
PWM:	Pulse Width Modulation
FWD:	Forward
REV:	Reverse
NO:	Normally Open
NC:	Normally Closed
EMC:	Electromagnetic Compatibility